

AUTOMATION AND ELECTRONICS IN PUBLISHING

Edited by:

Lowell H. Hattery and George P. Bush



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Paul W. Howerton, General Editor

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Computerized typesetting as applied at the *Washington Evening Star*. The operation consists of the use of a general-purpose computer for normal hyphenation and justification of news and classified body copy and several attendant by-products.

These by-products include volume and production statistics for management information and production control. Other by-products can help the editorial department lay out a better newspaper and keep many statistics that are presently not feasible.

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tion in the knowledge industry. Where the impact really will be felt; editorial and business implications. Typesetting as product or by-product? A unique system encompassing: creation, input, storage, updating, formatting, output, revising, reformatting, retrieval, and reproduction. A total system and what it will ultimately mean.

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Focuses on the many aspects of the printing industry that are related to electronics or automation. Represents the editors' impressions on a series of alphabetically arranged topics after informal discussion at the Institute, review of the recent literature, participation in other conferences, and informal interviews and discussions with specialists in all facets of the subject. Commentary is arranged topically and in alphabetical order. Following each commentary are references to item numbers in the Bibliography which relate to the topic.

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ABSTRACT

THIS BOOK is derived from a symposium in 1965 sponsored by the Center for Technology and Administration of The American University, which explored the electronic printing automation problem, its varied technologies, viewpoints, proposed solutions, and outlook. In addition to reporting the symposium the book includes a summary chapter and a selected bibliography of items.

Publishing and printing are at an evolutionary turning point, owing primarily to certain basic research in electronics and chemistry and to unique development into useful technological applications. Thus, printing has become cheaper, faster, and less dependent upon craftsmanship. Concurrently, it requires more sophisticated apparatus and human beings. As a consequence there are the inevitable changes both in obsolete machines, displaced workers, and peripheral readjustments in the industry. The trend is toward even more of the same because much so-called "fallout" from huge governmental basic research and development projects lies still unexploited.

The last chapter discusses the prognosis of this evolution. The bibliography contains about 200 entries with brief annotations restricted to items published after January 1, 1963.

Keywords: publishing, printing, electronics, automation, typesetting, management, photocomposition, optical scanners, communication.

FOREWORD

VOLUME 3 of the TECHNOLOGY OF MANAGEMENT series fulfills the objectives stated in the first volume by dealing with a current and controversial problem in the total area of automation. There are many ramifications of the Graphic Arts which have been automated with high degree of success and acceptance. Others have not been so successful. Both conditions have been examined in the papers here presented.

The comprehensive bibliography which has been compiled by Dr. Bush is a material contribution to the control of the literature of automation in the Graphic Arts.

The Center for Technology and Administration of The American University is very glad to be able to present this compilation of definitive papers to the people working in the fields of the publishing industry.

PAUL W. HOWERTON,
DIRECTOR, CENTER FOR TECHNOLOGY
AND ADMINISTRATION

PREFACE

PUBLISHING is again evolving by reason of various processes and methods which are approaching practicality at this time. It is important to the communications aspect of our culture that the state-of-the-art as of mid-1965 be widely disseminated. Communications are the very core of culture.

The trend for the future indicates a challenging and fascinating commingling of processes and methods in the Graphic Arts. Growth of electronic applications, automation, and other technological change inevitably conflicts with some long-held concepts on the part of some publishers, some printers, and some elements in the labor union movement.

The Center for Technology and Administration of The American University sponsored an Institute on Electronics and Automation in Publishing in May 1965 to explore objectively the state-of-the-art of the advancing technology and nature and extent of the problem of introducing change. The varied interests and viewpoints, the attitudes and outlooks, the alternatives, amelioratives, and preventatives were voiced but not necessarily reconciled.

This volume, while reporting the symposium, is not limited to the proceedings. Additional chapters and a bibliography have been incorporated. We have attempted to retain the informality of certain portions of the text; this we believe aids in communicating more precisely the essence of the authors' oral presentation.

We want to express appreciation to the contributors of papers, who were candid, and prompt, and willing to share their experiences and ideas. We believe they represent creative and pioneering contribution to the progress of technological innovation in printing.

We express appreciation also to librarians and others who have contributed to the bibliography.

Finally, we are indebted to Mrs. Barbara Mathes and Mrs. Mary Murtha, whose interest and competence were most valuable in manuscript preparation.

LOWELL H. HATTERY
GEORGE P. BUSH

JULY 1965

PART I

INTRODUCTION

Chapter 1

DEFINITION AND SCOPE

LOWELL H. HATTERY

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PRINTING is a major industry which is increasing in volume at a rate that exceeds the growth of the Gross National Product and that challenges plant capacity and personnel to keep pace with demands for volume and quality.

The electronic computer and related electronic technology are now penetrating printing and publishing. That the impact will be revolutionary is accepted. But many problems must be solved before the new technology is adapted successfully.

The technology itself needs further refinement. Components which may serve other applications adequately do not meet quality and aesthetic requirements in the Graphic Arts.¹

Personnel and union relationships require major attention and adjustment. Training and retraining, disposition of displaced employees, and

¹ The term Graphic Arts is not capitalized in the editors' dictionary, but it is capitalized in much of the literature in this field. For uniformity, we have followed the practice.

new union-management relationships are involved. The concept of the craftsman is changing.

The printing industry will undergo organization changes, some of which are under way. Will composition be done at computer service centers? Will commercial printers be combined into larger economic units? These and other organizational questions are facing the industry.

Many other questions face printers and publishers, including relationships with authors, job shop relationships with customers, and decisions about adjusting concepts of Graphic Arts quality for optimum use of the new technology without too much sacrifice of traditional standards.

SYSTEMS CONCEPT FOR PRINTING AND PUBLISHING

The electronic computer and other complex devices have forced new emphasis on the old engineering concept of "system." "System" has become the new focus of management. The systems approach is a requirement of effective modern management, which incorporates the electronic computer and related technology.

Use of the electronic computer requires adaptations to it in organizing information for input, the nature of the computer processes to be performed, and the nature of the output. Typically these adaptations require changes in personnel, organization arrangements, and procedures. They affect both originators and users of information.

Repeatedly in discussions of automated typesetting the "author" problem is discussed. Why? Because author requirements and author changes take on new cost and time dimensions with use of the computer. Optimum utilization of the electronic computer calls for limitations of author prerogatives. The author is therefore an integral part of the "computer typesetting system."

Consumers expect hyphenation. Hyphenation costs and time take on new dimensions with computerized typesetting. Consumer expectations and reader habits and skills must be modified for optimum computer utilization. Therefore the consumer is a component in the "computer typesetting system."

Management must focus upon this total look at the related, effective elements in automated typesetting—or, more broadly, automated printing and publishing.

Our attention and concern must extend not just to the fascination of the electronic computer but to the total technology; for the technology itself should be viewed as a system, from the machine which produces the original text to the machine that conveys the completed printed product. Each element affects other elements in the system. For example, optical

scanning for input to the computer conditions the typeface of the original keyboarding.

Even though steps toward automation are taken one by one, the total system should be designed in concept at the earliest stage. That the master concept will require change from time to time does not alter the necessity for full design at the outset.

Throughout the ensuing chapters almost every paper contains evidence which supports, directly or indirectly, the necessity for the systems approach to automation.

SIGNIFICANCE AND EFFECTS OF PRINTING AUTOMATION

Our culture is influenced and transmitted predominantly through the product of the printing and publishing industry. Cost, timeliness, availability, and Graphic Arts quality are critical elements in the greater effectiveness of printing on cultural progress.

Any new technology which reduces cost, facilitates distribution, and enhances the interest in and capability for reading is of tremendous significance to civilization.

One of the interesting developments of automation in printing is that the automation process tends to be a common denominator. Although each industrial process has its unique characteristics, automation tends to reduce the area of difference and increase the area of commonality among processes. The generalization applies to printing.

Evidence of this development is the need for new skills in the printing industry, skills which have been applied to other industries as well. These include computer programming, mathematical analysis, systems analysis, electronic maintenance, and computer operation.

Need for and participation in printing automation by persons who are not Graphic Arts specialists result in stresses and adjustments in the industry, revealed in various ways. Graphic Arts executives face a challenge in the incorporation of new specialists, new technology, and new methods into their enterprise.

OBJECTIVES OF THE SYMPOSIUM

The purposes of the symposium from which this book was derived were:

- to explore new and emerging technology for printing and publishing,
- to describe current experience in the use of electronic computers and other innovations for typesetting and other processes in printing,

- to assess the impact of these developments on organization, management and economics of printing and publishing,
- to examine the implications of new methods in printing and new forms of document output on intellectual communication and progress.

These matters are explored in the following chapters.

THE AUTHOR

Lowell H. Hattery is Professor of Management and Public Administration at The American University. He received his A.B. in Social Science at Ohio University, continued his graduate studies at Syracuse University, and received his Ph.D. in Public Administration at The American University. Prior to coming to the University he worked in the Department of Agriculture and the National Research Council. He has served as consultant to industry and government in management and data processing and has published a number of books and papers and edited others in these fields.

PART II

EXPERIENCE

Chapter 2

ELECTRONIC COMPUTER EXPERIENCE : A DAILY NEWSPAPER

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IN JULY 1963 *The Washington Star* became one of the first daily newspapers to install a computer for production purposes. We started with what we termed a “peanut” 1620 system. Since that time, we have grown considerably, but still within our original planning framework of 1962-63. We have a Model 1 40K 1620, a 1906 Buffer with 11 input lines and 15 output lines. In addition, we have a 1622 card reader punch and a 1311 disk file. Our operation, with this computer, covers primarily production functions, although some accounting jobs are performed. (Our accounting department has had a 1401 system for some time, which it uses for the many business office functions.)

COMPUTER JUSTIFIES AND HYPHENATES

Our computer application starts with a basic program for justification and hyphenation. The program is capable of justifying any typeface size and line width that the linecasting equipment will handle.

The method IBM has chosen to tell the computer that instruction information is coming is a dollar sign followed by an alphabetic character. For example, "\$QL" means quad left; "\$P" means end paragraph and initialize for the next paragraph.

The basis for justification is quite simple. The computer has stored in memory the widths of all the brass mats and the limits of space band travel. As each character is read by the computer, it subtracts the brass width from the predetermined line length until it gets within justification range. It then searches to see if a word space falls within this range, and if it finds one, it sends the line to an appropriate punch. It may attempt to insert extra fixed space inter- or intra-word, depending on desired hyphenation frequency.

If none of these works, and it is necessary to hyphenate, there is a separate routine immediately available. This routine first goes to the dictionary of words stored on the 1311 disk file and searches all pre-stored words which begin with the appropriate alphabetic character. If the word is stored, it checks which of the hyphenation points will fill the line and sends it. If the word is not in the stored dictionary, it then proceeds checking through a complicated logic routine, which includes checking for suffixes, silent E's, and hyphenation frequencies of associated alphabetic characters. One of these subroutines must come up with some answer, for it has to output a line. Hyphenation accuracy will vary from approximately 94% with no dictionary to 99+% with the dictionary fully loaded with appropriate words.

We have routines which tell us how the logic program would hyphenate any word or if it is already stored in the dictionary. If it will not hyphenate correctly by logic, the word can simply be decomposed and stored with up to four possible hyphenation points. Needless to say, no computer that we can afford will ever hyphenate 100% correctly as long as we have words such as pre-sent and pres-ent in our language. This one has caused us some problems here in Washington. Most of the year, pre-sent is more frequently used, but from Thanksgiving to Christmas we must change it.

GIVES PRODUCTION STATISTICS

The computer is virtually loafing doing the basic task of hyphenating and justifying, so we have asked it to do several more jobs with this same material to keep it from being completely bored.

The first additional job is operator-keystroke accounting. This keeps a record of the keystrokes by each operator and, when given the amount of time, computes the rate per minute. This is broken down into news,

classified, and display advertising. This, of course, is totaled. The information is available on command at any time if you want to check flow or for any other reason. The mere flipping of a sense switch will give a printout.

Linecaster statistics are also kept. This is accomplished by the punch being turned on or off. It keeps a record of the number of lines sent to each machine. It also keeps a record of the number of times it was detected "down," and the total amount of the "down time."

We have a real timeclock on the system. This is used primarily for linecaster scheduling or load balancing. The computer has a record of each font, mold, and casting rate of each of our seven Comets, five Elektrons, and one model eight. The model eight has a saw, so all variable line lengths are sent to that machine. The computer checks the amount of lines and time the last take was sent to each linecasting machine capable of handling the particular take, and sends it to the least loaded machine. The first codes on the output tape are visual and show font and line length as a double check for the monitor. Also, by using the internal clock, we can change the machine configurations for known changes in operating conditions. The balance is entered on request from the tape operations supervisor.

HELPS EDITORS AND COMPOSITORS

In addition to these production statistics, the editorial department needs some statistics to help them in laying out the paper. The first, which is story length, occurs in two different ways. Each day we store the configuration of the ads of each column of each page of the paper. A story then comes up marked for page A-10, column 1, and after the story gets keyboarded, the news editor gets a report which says such and such story on A-10, column 1, was plus 10 lines or minus five lines. If the story was not assigned to any particular place, he gets a report on the length of that story. This permits the editors to do a better job of editing, and thus produce a better newspaper.

We also keep 50 departmental counters for the news department. The counters are for measurement of content and can be assigned in any manner the news department desires. To illustrate—suppose the sports editor wants to know how much high school football, college football, and professional football he ran for a week. All he needs to do is assign a department number to each. He may want to compare the amount of copy on Arnold Palmer versus Jack Nicklaus. This now makes a very tedious job easy, and we can have a more balanced presentation of the news.

The last, but by no means least, of these statistics is the status of the paper. Historically, composing rooms run out of copy approximately an hour before the news deadline. The news editor always says he is ahead of schedule, and the composing room foreman calls for more operators to handle the last minute rush. Neither really has the facts. The use of the computer in this area will show where we stand in relation to the total load, taking into account assigned material, unassigned, shorts and any day, but discounting future date. It gives the answer in terms of number of operator minutes needed to make the edition on time and number of linecaster minutes required. The rates in both cases can be arbitrary or based on recent, actual experience. The future-date information is kept by day of the week, so it is available both for total daily output by category and for keeping the future date books straight.

MAKES WIRE SERVICE TAPE EASIER TO USE

The next item also fits into the plan very well. It is the handling of wire service tape where editing is required. Most metropolitan dailies have been unable to accept wire service tape, because the editing required too much resetting. For some strange reason editors invariably make a change in the first line of a paragraph. This change has meant resetting the entire paragraph. As a result, nothing was gained from the use of wire service tape.

The computer and the disk file have changed this. We now take the six-channel tape and store the stories on our 1311 disk. Each story is stored line for line, but all hyphenation and justification is removed. The editor gets his normal hard copy printout, but on paper that has been pre-numbered for lines. He in turn edits the story as he normally would. The only difference from their past practice is to eliminate the use of scissors. They now mark deleted paragraphs by crossing them out with a pencil, rather than cutting them out with scissors. The edited story is then sent to the composing room.

The tape perforator operators first identify the story by its code number and type the line number and first line of the story. This procedure identifies the story and is a double-check to be sure it is the correct story. Each subsequent line that is edited is identified by line number and the corrected line is punched. The computer then pulls the story from the disk and makes the necessary corrections. At the same time, it hyphenates and justifies for the typeface and line length desired, since it had earlier stripped the wire service instructions from the story. As you can see, editing of wire service copy no longer is confronted with the many restrictions formerly required. There is no longer a need to use a unit font

face, to set all copy single column and, probably most important, to turn over to a wire service the editing job that each newspaper must do. It is equally simple to integrate two or more wire stories into one single story, and add locally produced copy.

In the event the final story is too long to be considered a "take," the copy cutter can have the computer internally copy-cut the story into takes of approximately the same number of lines and send it to several line-casting machines. The computer takes a predetermined minimum number of lines (in our case 45) and then finishes off the paragraph. For each subsequent chunk, it gives an updated slug showing that it is part two, three, etc., of such and such story.

The big advantage in this approach is in elapsed time saved. A late-breaking story can be handled and proofread quicker than formerly. The fact that the hard copy and the output are the same is a help in accurate proofreading.

Another place where the computer can improve edition time is in the handling of the stock market. We receive the stock market information over a data speed circuit. This single tape is then cut apart with scissors and carried to each linecasting machine. The lapse in time to get all 12 machines running is fairly large. We now use the computer to do this allotting for us. Each machine is sent only enough material to get all twelve started and then it gives each one a larger take until the market is completely distributed. This has saved 36 machine minutes, which means we can go to press three minutes earlier on our stock final edition. If you don't think this is important, stand on any downtown street corner between 4:30 and 5:00 p.m. any weekday and see how many potential customers walk by. Of course, the use of a computer by the wire services to keep up with the stock market has materially helped also. This same procedure can also be used for important texts, such as the inaugural address, which occur during the height of our publishing day.

PAVES WAY FOR PHOTO-COMPOSITION

Up to this point I have been talking only about news and classified body text. This past winter we have added a photo-composition program to our "repertories." This program was written jointly by IBM and another newspaper, the *Miami Herald*. It is now being used in several newspapers and by commercial printers. The program can be used on either Linofilm photo units, or Photon photo units. The *Star* has been using the Linofilm system for over five years now, and a good percentage of its display advertising has been set by this technique.

The Linofilm system uses a complex and expensive keyboard which

produces a 15-channel tape to run its photographic unit. This keyboard has a capacity to handle 18 typefaces at one time. There is a printed circuit card which gives the width for each character of each face. These cards may be pulled and others substituted at any time. Obviously, a computer with a disk file can store the same information. In addition, the keyboard computes line length and signals the operator when he is within justification range. The hyphenation and justification program in a computer can do the same. The only problem then was the 15-channel tape for the photo unit versus the 6-channel tape. This was solved by Mergenthaler, who has built an adapter that reads three series of punched holes on the six-level tape for every output line.

We now are in a position to use the same keyboard for photo-composition that we use for news and classified hot metal setting. The so-called instruction commands are created by using a super-shift position on the keyboard. All this does is tell the computer that everything to follow is an instruction. At the *Star* we use the rail key for super shift and the un-rail for unsuper shift. All of the instructions are in symbolic language. For example, to change a grid the code is "CG."

In addition, one can store up to 100 formats "in memory." A format routine in this instance is for combinations that are repeated over and over. Each format message can contain up to 100 characters of instructions and/or copy. Sears, for example, uses the same style for its copy blocks in all its ads. There is a certain face in a consistent point size for each heading. This is always centered. The next item is the former price and sale price separated by leader dots. After that comes the descriptive copy. Each of these portions always follows the same style, but the amount of grid changing, leading changes, point size changes, quad left, quad right, quad center, and justify, makes it a natural for a format routine. Another example is grocery copy.

There are many other features of this program which would be very difficult to do with a Linofilm keyboard. Tabulated copy is the first. We can use as many as 20 different tab positions in one line. These can be tab left, tab right, or tab center. In addition, there is a routine called "tab computer". This routine divides the available space into the number of tabular positions you desire and sets the tab stops. Tab proportion does the same thing on a proportionate basis. Quad right, left, and center, and from center are available. Ragged right, left, center, and middle, make the mark-up man and operator jobs much easier and give the customer refinements that were extremely difficult to do.

Indentation instructions not only are useful for lines and paragraphs but also can be used to position copy blocks in relation to each other to

help the final paste-up man in his job. In many instances, a good mark-up man can lay out an ad so that it is a single paste-up operation for all the text matter.

As can be seen from all this, we now can do all keyboarding from a single keyboard. The operator does not have to memorize many different types of keyboards and thus can concentrate on the job to be done. In addition, we can now bring the work to the operator rather than have the operator move from machine to machine. This should give greater protection to the news operations for unanticipated, late-breaking stories without requiring serious overstaffing.

EVOKES QUESTION ABOUT BACK-UP

Back-up is a problem that has concerned many of us, especially now that we are putting more and more of our eggs in the computer basket. As of this moment, there is no pat solution. Perhaps volume will dictate need for a second computer, or we can use other newspapers via data-speed-networks. The specialized gear needed to handle six-level tape means quite an investment with other non-newspaper computer users in your area. At this point, we have sufficient equipment to handle conventionally the few trouble spots we did encounter. It is a potential problem which concerns us though.

In addition to our composing room operations, we do have several other programs running on the IBM 1620. We are converting newsprint inventory, claims-handling operations, and newsprint break-record reports to computer. We also do some accounting routines that are better suited to the 1620 than the 1401, and we are now debugging a program that we wrote to keep our records on our fleet, which amounts to 245 vehicles.

BUT IS A "NECESSARY TOOL"

Needless to say, we have just scratched the surface of operations that can effectively be handled by a computer. I think it is a necessary tool if newspapers are to continue to be the dominating means of communication in the years to come.

THE AUTHOR

Willmott Lewis, Jr., the Production Manager of the Evening Star Newspaper Company, joined the company in 1949 after having attended Yale University. Additional activities include serving as a member of the Board of Directors of the Evening Star Newspaper Company, Secretary of the Evening Star Broadcasting Company, Vice Chairman of the Production Management Committee of the American Newspaper Publishers Association, and Secretary-Treasurer of the IBM Newspaper Computer Users Group.

Chapter 3

COMPUTER SYSTEMS AND NEWSPAPER PRODUCTION

RONALD A. WHITE

*Production and Engineering Director
Scripps-Howard Newspapers*

THE NEWSPAPER PRODUCTION process has evolved to meet a set of unique demands. The idea born to the reporter and the concept of the advertising artist must be made tangible. External events become elements in the production cycle. Full cycle occurs many times each day, for it is not unusual for a metropolitan newspaper to deliver a "new" product from three to seven times daily. Add to the above a requirement to produce a product variance of 300% day-to-day and the newspaper production system promises an unfailing challenge.

I was asked to discuss the systems concept, keeping in mind that the audience includes a cross section of those who are interested in publication and document communication. I hope I can bridge the communications gap.

As a technical graduate, I was taught the ground rules of steel standards, wire standards, chemical standards, and the like. Since I know the newspaper industry has no uniform yardsticks, I sought a firmly grounded, standard unit from data handling and from the publication field generally.

Any paper which deals with the application of machinery—electronic or otherwise—to an industry must refer to uniformly defined units of production. Well, I couldn't find the compatible unit.

The newspaper can be considered a total production system consisting of two raw material inputs and one output.

Input A is news data. Input B is advertising data (we call it store news). Output is a finished newspaper at the tailgate of the truck or at the point of contact with the customer.

Within this over-all system, there are several discrete units, some making up sub-systems. Today we'll think in terms of the whole system, but talk about the individual units as integral process systems and, where applicable, with feedback loops.

Let us start with copy—editorially produced or advertisingly produced—and end with the newspaper on the bed of the truck. There is a whole area of computer application in the scheduling, optimizing of routes, minimum trip travel and so on, but this operations phase I am going to duck.

In the previous chapter, Willmott Lewis introduced the concept of a single keyboard for composition of both news and advertising matter. Current newspaper industry practice has developed an effective routing of copy through two separate composing units—an ad end (colloquial reference) and a news end. (However, some newspapers have programmed their linecasting machines to serve both functions, ad composition and news composition.) But now, with computer assistance, a single keyboard can produce six-level tape for activation of a hot metal linecasting machine or a photocomp machine. We now can direct the copy from source A and source B to a single point—a first step for systems control.

In the first phase is a man-machine system wherein proper information, be it from the editor or the mark-up man, to the keyboard operator is translated into machine instructions, and the detail work is performed by the computer.

To digress just a moment—users of data-processing gear and the data-processing industry are straining very hard for uniform machine communication. Through the American Standards Association and the Business Equipment Manufacturers Association, there is now under study a standard code for information interchange. We've been privileged to know a little of the desires in this area, and if you think we, in printing, have problems tying down a uniform definition, you should listen to these fellows trying to solve the problems of a uniform language for machine communication. But one thing has been evident: the six-level tape as we know it for in-house operation of composing machines and for machine communication has to die. A five- or six-level subset within

the suggested eight-level structure may be developed for future news wire use, but before long the six-level system joins the dodo.

A newspaper, from typeset to lock-up, flow charted, would show, from receipt of copy, an operation taking place at the keyboard, followed by a transport—the carrying of tape either by wire, manually or conveyor—and then tape storage at the linecasting machine. Juxtaposed would be shown a linecasting machine operation using the tape as the functioning medium, again followed by a transport—the slug's being moved to the proof press where the slug is the origin of a new system, and a transport to storage at the bank awaiting corrections. The new system is the correction loop.

We will treat the series of sequences as the typeset system: from copy receipt to corrected type delivered on the bank. There are various ways to treat this system, and one concept is being tried at the American Newspaper Publishers Association (ANPA) Research Institute. It is an interesting system for it has the potential of self-correction—a feedback loop.

The system as it currently operates makes principal use of the computer at the operations step of the tape phase. Here the computer power is applied to the decisions for hyphenation and justification. Further development will apply the computer energy to other steps and compact the system.

The error factor in typesetting requires that the ultimate system have feedback capability. Operator errors are in the 3 to 6% range, machine errors are over 1% and, depending upon the technique, electronic errors in the hyphenation decision can exceed 1%. (The % is based upon reset lines per hundred lines.)

The fire is thus directed at the correction loop—the proofreading sequence. An approach to the problem would have the tape produced at the keyboard read into computer memory and the machine deliver a hard-copy printout. The printout is proofread and a correction routine similar to that which Mr. Lewis has described is utilized. We now can release a tape to the linecasting machine, and if we are prepared to accept a machine error basis in hot metal of 1% or less, we can go directly to lock-up.

If we are dealing with photocomp machinery, the machine error is so minimal that the corrected output can easily be moved to final paste-up. The next step is to eliminate or make unnecessary the initial proofreading.

I visualize the progress in systems control of typeset to bring Optical Character Recognition into the picture. In the critical manufacture area for typeset, the scanner-computer combination has the potential of a full process control system.

The system in use today has a duplication of effort at the keyboard. News copy is typed, edited, and delivered to the composing room. The second effort, almost precisely duplicating the first, translates the copy to machine language.

If, at the input to the scanner, we assume there is clean copy, the system is straight line with a feedback potential, if necessary. Preparation of scanner copy will be an area for much improvement and study, but for this paper we will assume that the copy is correct. Proofreading, if deemed necessary, can take place before the copy enters the production system.

The delivery from the scanner can be tape for machine activation. At the same time there can be delivered a printout of the tape content. After processing, the printout can be compared to the machine output by running both through a versatile scanner, and verification can be established.

With no verification, a program for correction can be set in motion. It is foreseen that the correction tape would be self-generated and the correction product delivered for collating. With attempts such as these, we will have established a most important concept—the system potential from copy into type on the bank can be predicted from input—similar perhaps to processing techniques now available in chemicals, oil, and others.

An alternate system, however, can evolve with the use of graphic display equipment. Initial input to the system then will most likely be impulses direct from the keyboard. Editing and proofing techniques will evolve using light pen and keyed input, and impulses for output will be delivered directly to the manufacturing device. Paper tape storage, cheap though it is, may pass on. The accuracy of the composing unit will dictate technique from this stage.

For the newspaper field, the scanner appears to fit the system requirements with more flexibility than the executive monitor system just mentioned. To show why, let us turn to another area of utilization with the scanner and pass on to other fields.

Advertising copy input to the typeset system is a two-pronged entry. Area composition material and line production material make up the two categories.

The keyboarding effort in the classified sales department gives source documentation for billing and associated accounting work as well as input to the production system. The scanner-computer unit can split out the initial effort to the benefit of both accounting and production.

The photocomposing developments described by Mr. Lewis fit a scanner input system. The copy receipt from the sales department always

carries with it billing information, and the keyboarding for input to the system can cover billing and production information just as it does with classified.

Much work remains in the field of character recognition and verification techniques and perhaps the evolution will show a blending of the scanner and the cathode generator. We'll not walk that path today.

The sub-system we have discussed has had as its defined limits, copy input and type or image for lock-up as output. We will leave the system at that point, ignoring the generation of page make-up by electronic methods. Nor will we pursue the reproduction of this image through various printing techniques.

There is one by-product of the system that should not be ignored—the reference library. The source input, regardless of technique, is the origin from which the library will develop. The newspaper information storage and retrieval system will develop as a by-product of production input.

We propose that the techniques of process control could be applied to the newspaper typeset system. Further, these techniques can be applied to other phases of newspaper production.

On-line control and monitoring of a continuous process is not exact in typeset but is in the press room. The computer ought to be considered for this and other jobs.

The typeset requirement is not demanding on the computer. However, newspaper typeset is basically an on-line requirement, and difficulties arise when attempting to block out time. Why not time-sharing, on-line, of a multiplicity of production functions? In the newspaper we might suggest typesetting, machine monitoring, press control, press monitoring, and inventory status.

Business computers are designed to process large amounts of accounting type data. These computers are generally operated on a batch-type basis, program run-in, job run, results delivered, and then, on with the next task. They are usually set up to follow a fixed sequence of operations, and to do so rigidly.

The scientific computer is designed to perform large amounts of complex mathematical calculations and with extreme speed. This device has enjoyed its greatest success in the newspaper business, in typesetting, because it proved easier and more economic to adapt to the hyphenation and justification routine.

Now, the control computer is about to make its presence known. Its power rests in its ability to monitor many operations on-line and assist or make the decisions for real-time control. To do this, the computer must continuously determine priorities for the tasks it performs.

Because it operates on-line, it accepts live signals from many and various sensors which measure process variables, and it generates the signals to activate process control devices. While performing these functions, the process control computer can communicate directly with the business data-processing system. Information is available on an up-to-the-minute basis, and management has a total information system.

Within the production system of the newspaper (and perhaps most publication printers) is a process control application of almost textbook requirements. From the time a newspaper press starts up until the run is completed, we can give the press operators full on-line status and develop quality control through feedback. And this capability is available on-line with the same computing device that is assisting composing room typeset.

As the press gets underway the individual newspaper output can be sensed and recorded. Status reporting is automatic and on-line. Visual displays can be utilized for complete information systems. Data such as current averages, total output, and time-to-completion can be instantaneous display or by interrogation. This is management information, but now let us put in a feedback loop.

A newspaper operates within a limited time span. Demands are not on a 24-hour basis; therefore, equipment investment is high because percentage utilization is relatively low.

Once a press or a series of presses is on production, the individual newspaper can be sensed as a unit of production and totalized within the computing mechanism. At this time we can develop full feedback process control. By knowing the edition schedule and using a predetermined press average and/or a predetermined time of run, we can monitor continuously during the production run and determine whether production is ahead or behind schedule.

Thus at any point in time there is a comparison and, if this is negative, a signal can be sent to the press requesting the press operator to increase his operating speed; or the signal may operate directly to the drive (with operator over-ride at all times) and increase the press speed—a straightforward production feedback loop.

For the completion of the run, the presses can be brought down automatically at the end of the predetermined quantity of papers. A tremendous advantage is available to press operators at this point because now the electronic monitoring devices balance up the load on each press and as the order is reached the control unit automatically brings the machinery to rest. This eliminates one of the problems that occurs in a newspaper, shutting down under manual control, attempting to hit an

exact number. What usually results is that there is an over-run or an under-run of the order.

In the case of an over-run, there is a waste factor. In the case of an under-run, there is a short run start-up during which quality is less than desirable.

Production process control feedback—it applies here and applies in any publication or printing house.

At the completion of a press run you can print-out accumulated information detailing exactly what happened for post-run analysis. Information can be made available on time-start, time-finish, running averages, top speed or any of the control factors that can be defined using sensor input on a real-time basis.

Process quality control is applicable to the newspaper press. The press can be considered as a newsprint conversion unit. Newsprint into the press system can be monitored during the course of the run, for quality, for mileage, and for any measurable variable.

For example, the running weight of a roll of paper can be entered into the computer and associated with measured mileage for basic weight determination.

The roll of paper may be monitored during performance to check web breaks, or core breaks, and perhaps, eventually, even to check why. Though the information is developed on-line, the generated reports are used in post-run analysis. The feedback is through management-supplier action.

In chemical, oil, or steel process control, the material being processed is constantly under quality check. The quality control check may be measuring the thickness of the sheet, or may be evaluating the proportion of the chemical constituents for the solution being processed. Process control with feedback similar to that used in the industries just mentioned will be developed for newspaper presses in the near future.

One of the great problems in a newspaper is the exact flow and thickness of the ink to be placed upon the sheet. There are devices installed on press equipment which are forerunners of the sensors that will permit on-line quality control. At DRUPA a few years ago a sensing device was installed on an offset press. Work has also been done in the roto-gravure field. The principle is known but technology has yet to develop a successful sensor.

As the paper is flowing through the press, a change in voltage, perhaps, can be measured and compared, and corrections to the ink flow can be made or can be requested by the computer. Thus a quality control feedback process application will give for the first time in the newspaper

proper ink regulation. The ability to be uniform has not been available to date.

In newspaper publication the dearth of records and the very deep detail work that it would take to know optimum conditions have not permitted us to keep track of what we should properly be doing. The number of webs, the number of sheets of paper in a newspaper press in a major city, can vary from 2 or 3 up to 9 or 10. Stated another way—single press delivery can vary day to day from 16 to 144 pages. Somewhere in the range of press run, press average, number of press units and number of webs in use, there is an optimum or standard of productivity that has never been roped and tied. With the computer and with the ability to gather, assemble, compare, and analyze information, we can optimize for the ultimate in press layout and productivity. We will know for the first time precisely where we stand. An obvious benefit to the newspaper will occur in planning capital investment.

The composing room load in the daily newspaper has been considered an almost insoluble problem. The application of process control to the line production machines is limited, but on-line status reporting has strong potential.

There are several known factors that can be plugged into the process control unit. Among these are number of machines available and machine output, number of operators and operator output, the size of typeset load as determined by editorial space, and time to close. On-line, the machine output would be sensed and recorded as would operator output. The computer, upon interrogation, would then produce the exact copy requirements for the time remaining to lock-up (or in a more normal case, tell you how far close-up will be missed).

Such reporting techniques will permit evaluation of load, hiring practice, machine complement, machine performance, scheduling—in short, what every manager should know.

Two distinct process departmental applications have been discussed. Each has been treated as a system within the total system and a check back will show that the development of process control will carry a quality advantage and tedium will be assigned to the computer machinery. Another point to note is that the departments most readily adaptable to process control are the two with highest operating expense and greatest capital investment.

There is discussion within the newspaper industry about a system in which copy input moves electronically to an electrostatic printing device and the image changes on each rotary pass. Also, facsimile is again being discussed. As stated earlier, we will not step out upon those

waters, but the purpose in restating them is to point out that these and other future systems are on-line process control applications.

Thus, the industry must take control system steps now to prepare itself. There is a question as to which road, but little question that the final road is straightened by process control.

Within the total newspaper production complex is the previously mentioned sub-system which is in itself a conversion industry. The system can be designated as the paper-press-mail system.

Developments in material-handling equipment permit the completed newspaper to be counted, stacked, wrapped, tied, and delivered to the waiting truck as a continuous flow process. Because of the proficiency exhibited in the area, the press room and mail room are coming to be thought of as a single entity. Therefore, the mail room has not been discussed.

The raw material input, newsprint, has bulk and measurable qualities and it must be scheduled and controlled. A quality control check was discussed earlier, but now we look at raw material inventory and scheduling. FIFO inventory can become a reality. Optimum order points can be developed. The tool to evaluate each change statistically, as it relates to performance, is available.

The discussion has stayed within the production departments to this point. However, in closing, there is an area of electronic usage that will be touched upon briefly. Perhaps the best term to encompass the area is record-keeping.

Adequate and uniformly established records or measurements of productivity are not found within the newspaper industry. The computer and keyboard inputs permit the development of meaningful and comparative records. Eventually all input units can be developed upon a key-stroke base. Maintenance history can be analyzed for the application of true preventive programs. Job cost analysis can make available a cost control tool not currently utilized.

I believe the most intriguing developments will come in this area. The reports and analysis are almost by-products of production input. And these tools potentially give management its greatest need—system information.

THE AUTHOR

Ronald A. White started in the newspaper business in 1944 working as an apprentice pressman and journeyman pressman in Detroit until 1953. During this time he attended Wayne State University where he received his B.S. degree in 1953. Since 1953 he has held various positions in the newspaper trade and is presently the Production and Engineering Director of Scripps-Howard Newspapers.

Chapter 4

COMPUTERS AND SCIENTIFIC PERIODICALS

JOSEPH H. KUNEY
American Chemical Society

IN THE PUBLISHING of scientific periodicals, no less than in each place where the impact of the computer has made a mark, we have turned our attention to thinking about the total pattern of scientific communication, or, as the computer people have taught us to say, "systems analysis." In this discussion I shall cover some of our thinking on:

1. A system concept of scientific communication,
2. The present status of our efforts and progress, and
3. What we might expect as the publishing pattern of the not-so-distant future.

A basic problem of the scientific periodical has been that of keeping pace with the changing needs of the scientist. The needs of our expanding population and the desire for improved economic status create pressures for scientific and technological progress. In response, new patterns of scientific activity develop faster than traditional methods of scientific communication can adjust to the change.

The traditional pattern of meeting the new needs of scientists has been to publish more and more material in more and more journals. Where

once the *Journal of the American Chemical Society* satisfied the basic literature needs of the chemist, today the American Chemical Society publishes 17 journals, and the pressure is always on to publish still more. A characteristic of each new journal is its coverage of a more specialized area of chemistry or chemical engineering than its established predecessors. The American Chemical Society (ACS) now publishes journals covering the fields of organic, inorganic, physical, and analytical chemistry. Biochemistry, medicinal chemistry, chemical documentation, agricultural and food chemistry, and industrial and engineering chemistry are also covered. In each of these topic areas will be found many journals published by others dealing in still more specialized coverage. In all, we estimate that throughout the world some 2,000 journals deal principally with some aspect of chemistry. To get complete coverage of all publications of possible interest to chemists and chemical engineers, *Chemical Abstracts* looks at some 9,000 different journals from all parts of the world.

The volume of publication continues to grow, and with it the concern as to how good a job is being done in getting this material into the hands of the scientist who can use it to advance his work. A sign of this concern is the emergence of a profession dealing with the problem of aiding the scientist to gain access to the literature he needs. Today most companies of any size employ specialists to screen the literature and direct it to the people who might benefit from its use. In addition, there are now publications or "services" designed to alert the scientist about literature he might otherwise not see. Included are publications carrying tables of contents of journals, lists of titles arranged by keywords, references based on literature citations, and a variety of more specialized services. These publications or services aim to cover the primary or journal literature, and the report or informal literature is still another problem area.

THE PERIODICAL IS THE RAW MATERIAL

The scientific periodical remains the basic raw material of the existing scientific information systems. Figure 1 shows one way in which we might try to illustrate the problems of scientific communication:

1. First there must be someone with a message he wishes to communicate.
2. He can do this by personal contact via visits, phone calls, scientific meetings, seminars, etc. This approach is limited by time, available facilities, and cost.

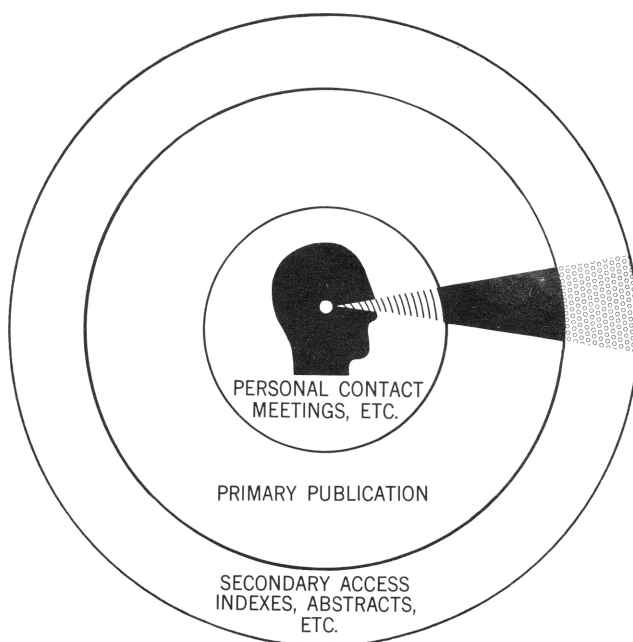


Figure 1. Conceptual version of the information system.

3. The next step in reaching more people is publication in a journal. Roughly we can think of the total area covered as exposure to readers, and the width of the band as extent of subject coverage. The narrower the band, the more specialized.
4. Lastly there is the information retrieval problem. Here we include abstracts, indexes, and the many specialized services mentioned earlier.

If we think of the circle as divided into arcs representing subject areas such as chemistry, biology, and physics, we could further divide the outer area, depending on the breadth of coverage of the information retrieval tool. Some tools such as *Chemical Abstracts* or *Biological Abstracts* would cover an entire subject plus some overlapping. Other more specialized services would tend to include small parts of several subjects. The amount of time and money available to do the job is the limiting factor.

Figure 2 is another way of looking at the problem. Here it is a little clearer that the author has alternatives to journal publication, sometimes of his own choosing, and sometimes because his work finds no suitable outlet or is rejected for some reason.

Here we are beginning to see the makings of a system and what the availability of computers is doing to get us thinking about fulfilling the needs of the system. We need not think too long about the problems of men, costs, and equipment to realize that the best place to start is near the source. In our thinking, one such source is the publication process of a scientific journal.

Thus, if we are going to set (by a keypunching process) the journal in some form which will be used in printing, why not add the coding which will enable users to retrieve the material for use or further processing at every subsequent stage in the total process. For example, as we punch a paper tape for computer typesetting, we can include codes which will enable the computer to be used in the production of bibliographies, indexes, abstracts, and in the retrieval of documents and data. In addition, we want to think about the possible direct use of the original coded tape in specialized information system centers.

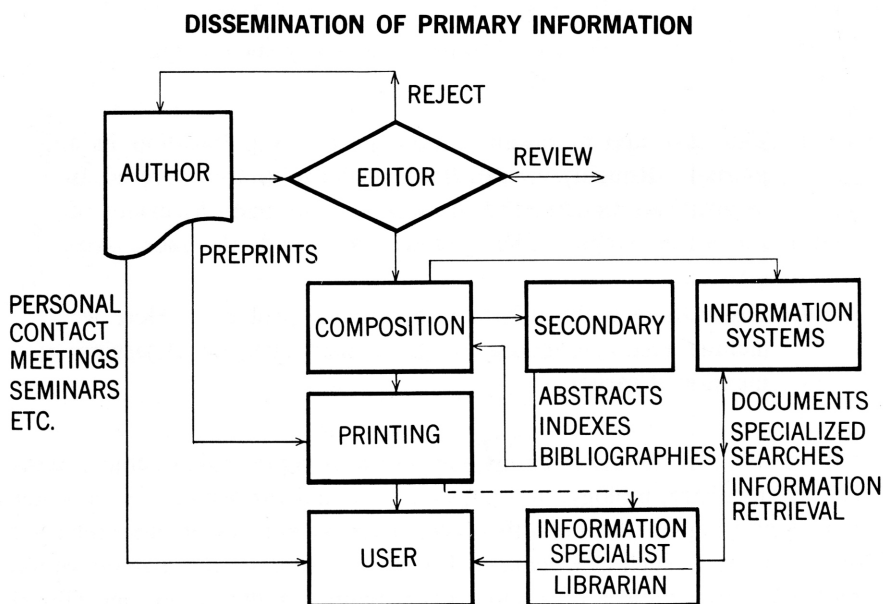


Figure 2. Flow chart of dissemination of primary information.

TODAY'S NEEDS

Composition for scientific publication—with requirements for a wide list of special characters, frequent changes in type fonts, large amounts of tabular setting, mathematics and chemical structures—poses problems which have not yet been widely attacked despite the growing interest in computerized typesetting by the Graphic Arts industry. The bulk of the activity has been in the use of the computer in preparing justified and hyphenated tape for operation of hot-metal machines.

In our current work, which is supported by a grant from the National Science Foundation, we are seeking to develop computer programs which will produce tape to operate a photocomposition device for setting scientific manuscripts. Specifically, at this point in time, our photocomposition device is a Photon Model 200 specially equipped with both six- and eight-channel tape readers. The double eight-channel tape (two rows of codes per character) carries all necessary spacing information required for justification, font, and size changes. It operates directly into the photographic unit of the Photon. The six-channel, automated set card unit reads the TTS tape which has been set to permit justification and other changes through the keyboard of the Photon. Thus far we have used the computer to produce eight-channel tape. The eight-channel acts as a sync-hole and controls certain functional operations.

Through the cooperation of the IBM Advanced Systems Development Division at Yorktown Heights, N.Y., we have been able to test two approaches to computerized typesetting. While they wrote a program for the IBM 7090, we provided know-how on publishing and composition problems, prepared the input tape, and ran the output tape.

In a second approach we have worked on a typesetting program for the IBM 1460 which we have inhouse for the handling of membership records and subscription fulfillment.

Input to both computers is eight-channel, unjustified paper tape punched on a Flexowriter. By design, we use the same coding system for both computers. The 7090 program has successfully handled several takes of a variety of copy. We have not as yet done enough to get any cost estimate. On the 1460 effort we have made a few test runs and hope to demonstrate shortly.

It is apparent that we must find simpler methods of inputting instructions to the computer if we are going to develop an economic system of handling scientific material at present levels of typographic style. We plan to study simplification of format as a possible solution, but for the moment we are going ahead on the basis of present styles of typography

as used in the respective journals published by the American Chemical Society.

One promising approach to reducing the amount of instruction coding the input operator must use is the use of a "paragraph format" control card. A sample is shown in Figure 3. This information is punched on a card which carries keys to a series of main instructions which control general style such as typeface, size, line length, leading, word spacing, indentation, etc. The numbers in the first row control all of the functions on the respective horizontal rows. Figure 4 shows a part of the input of one of the tests as it was punched on the Flexowriter. The numbers shown in reverse are the format control cards which are punched on the ribbon shift code. The circled characters in the text are the precedence codes and the codes used in effecting disc and lens shifts on the Photon.

These instructions or format codes can also be used in secondary use and retrieval. For example, the abstract style will always be unique and could be recalled on the basis of the format code to reproduce a series of abstracts only. This procedure could be followed in the production of indexes, bibliographies, author lists, and sections of manuscript.

In cooperation with Inforonics, Inc., of Maynard, Mass., we are engaged in testing a system designed to prepare manuscripts for publication in a manner which provides identification of the various parts of a manuscript for information retrieval purposes. The main feature of the Inforonics system is the use of a series of carriage returns, spaces, and tabs to tell the computer about changes in type, leading, etc. For example, the job-line header sets up a previously programmed format description for setting the heading or title line. If this line is followed by two carriage returns, the next item is the author's byline, and the proper setting instructions are issued. If the byline is followed by two carriage returns and two spaces, the next copy is set as text. There are similar conventions for the setting of side heads, center heads, footnotes, run-ins, etc.

Within text, special characters are called by the use of an assigned key to call up a new keyboard arrangement. This again is, in effect, a series of macro instructions in which a single code sets off a series of steps within the computer program. The choice of special characters is limited to those included in the alternate keyboard arrangements. The Inforonics typesetting program is written for the PDP-1 computer.

We are at present evaluating this approach under actual publishing conditions. Several articles have been keyboarded at the Inforonics plant using a six-channel Flexowriter to produce input tape to the PDP-1; double eight-channel tape was produced as output for processing through

PARAGRAPH FORMAT CONTROL CARDS

A code header card must be the first card of the text style control cards. The data punched in the card will be as follows:

Card column 15 - Units for horizontal sizes are: 1 = Points

NOTE: The columns indicated by "a" below must be in same units.

Card column 24-25 - Prelead

2 = Hundredths of an inch (BOD characters)

Card column 26-29 - Page length

3 = Photon units (640 per inch)

Text Part ID No. (Additional blank cards)	Font (1-16)	Type Size Factor	Lens Number	Size Increment (Points)	Min. Size of Inter- word Spacing (a)	Vert. Space Before Entry (Points)	Lines of Entry (Points)	Vert. Space After Entry (Points)	Position of Text in Space*	Indentation in Space*	No. of Lines for control line base control**	Left Indentation (a)	Right Indentation (a)	Vert. Points for which leading con- trol is used	Left Indentation (a)	Right Indentation (a)	Placement Rule**	Width of Column (a)	Item	
1-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-30	31-33	34-36	37-39	40-42	43-45	46-48	49-51	52-54	55-57	58-61	62	80
1	7		10		8mv	35	25	30	3	4								7x640	Title	
2	8		6		8mv	32	12	30	3									7x640	Author	
3	7		5		8mv	27	11	35	2	2	999	760	760					7x640	Abstract	
4	4		5		8mv	23	35	10	0	1	2								Abstract paragraph indented paragraph	
5	4		5		8mv	23	35	10	0	1	2	1	80							
			5		8mv	23	10	0	1	2	0	0	0						Side Head	
6	8		6		8mv	32	25	10	0	3	2	0	0						Side Head	
7	4		4		8mv	19	15	9	0	1	2	999	0						Side Head text	
-1																				

(This card must be the last card of the text control cards.)

*1=Justified and hyphenated
2=Justified, no hyphenation
3= Quad left
4= Center
5= Quad right

**1=No control change
2=Reset line base control
3=Reset Leading based control
4=Reset both controls

***1=Continue after prior text
2=Begin new column
3=Begin new heading
4=Begin new page

(This card must be the last card of the text control cards.)

Figure 3. Sample "paragraph format" control card.

job 209, ed97, jced, bgl, phot

1 Condensation of Cyclohexylacetone with Benzaldehyde, Nitrobenzaldehydes, and Chlorobenzaldehydes

2 ILGVARS J. SPILNERS, JOSEPH J. McGRATH, and JOHN P. PELLEGRINI, Jr.

New Products Division, Gulf Research & Development Co. Pittsburgh, Pa.

3 Cyclohexylacetone was condensed with benzaldehyde, nitrobenzaldehyde, and chlorobenzaldehyde under conditions which favor condensation at the methyl group of cyclohexylacetone. Straight chain benzylidene ketones were obtained in 63 to 79% yields from all benzaldehydes except from

nitrobenzaldehyde, and chlorobenzaldehyde.

4 UNSYMMETRICAL KETONE may undergo condensation at either of the two positions adjacent to the carbonyl group. To prepare new straight chain benzylidene ketones from an unsymmetrical ketone, cyclohexylacetone, whose steric hindrance may favor condensation at the methyl group, was condensed with benzaldehyde, nitrobenzaldehydes, and chlorobenzaldehydes.

5

600

Figure 4. Flexowriter hard copy of input to computer.

our Photon. We are nearing the end of this project and I can say at this time that film has been produced by this method.

All of the work to date has been limited to the handling of text, including heads, bylines, and literature references. We are preparing to tackle mathematical setting and tables with the realization that it is not going to be easy. However, we have had some success in the setting of chemical structures, using a computer.

The system we have evolved is based on the input provided by the chemical typewriter developed at Walter Reed Army Institute of Research. This typewriter is a tape-punching device equipped with special characters which can be used in typing chemical structures. Thus, as the operator types, a hard copy of the structure can be produced. At the same time as the structure is typed, a tape is punched with the code of the character typed and an x- and y-coordinate is given to each character, thus assigning each character to a specific place in the chemical structure. The operator may type the structure in any convenient manner without regard to order. The punched tape is fed into a computer which is programmed to rearrange the codes for line-by-line printing. If we add the additional step of converting the output code to Photon codes, we have a method to set chemical structures via the computer.

With the excellent cooperation of the Photon company, a test disc was developed for the chemical typewriter. Using this test, we have set some sample structures manually as shown in Figure 5. In addition, one rough computer test has been run to show that the method described above could be used. At present we are working on plans for a more sophisticated approach to structure setting which should be more flexible and

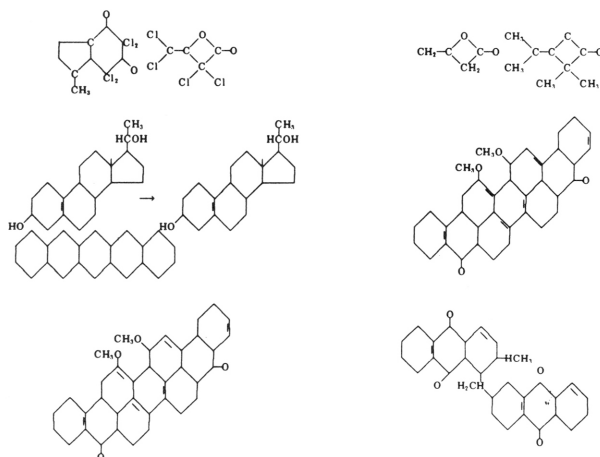


Figure 5. Sample of manually set (Photon) chemical structures.

more adaptable to computer handling. This approach is based on an atom-to-atom connection pattern rather than direct key-to-character usage. A proposed matrix setup, using only straight-line matrix segments, has been explored with the Photon company and deemed feasible. After a preliminary analysis of the programming problem, we plan to start production both on a new matrix disc for the Photon and on writing the necessary programs.

The work on setting of chemical structures is related to the efforts to develop search techniques for coded structures. Chemists face the problem of coding and searching the more than two million known chemical compounds. New compounds are being prepared almost daily. If, as some workers claim, the codes used in the composition of chemical structures can also serve as a basis for searching techniques, then the whole will add up to a very important development to the total system of chemical information.

The work to date on the use of computers in scientific periodicals is hardly out of the exploratory stage. We know we can use the computer to set type and to set chemical structures. Many problems remain unsolved, including the obvious ones of setting tabular material, mathematics, and the handling of corrections. In addition, we have hardly begun to test the use of a machine-readable record in all phases of the total scientific communication system.

WHERE TOMORROW

Before looking ahead, let us refer again to our system concept (Figure 2). As you can see, the change has been to introduce the computer at the

composition stage. This, in turn, sets the stage for some modification of our procedures, most of which have been described earlier in this paper. Otherwise the over-all system follows the traditional pattern of providing communication between scientists.

One change which may affect the thinking and planning of those in the Graphic Arts industry is the keypunching operation. It is our estimate that the key- or tape-punching step will take place in the editor's office. Where the computer processing will take place is still very much open and depends on (1) developments in time-sharing of computers, and (2) whether or not general-purpose computers or hardware designed specially for typesetting proves more economical. Quite likely, the typesetting run from computer tape will be done by the printer or some form of service operation similar to trade composition plants.

It can be seen, also, that if character-recognition devices are used for input, and high-speed photocomposing machines for typesetting, the system remains little changed. But we will have to learn a whole new approach to the man-machine problems which result from the electronic capabilities of our equipment.

We are just beginning to sense that the speed of electronic equipment may produce some basic changes in our handling of scientific information. First, the user of scientific information must become much more involved in the process than he has to date. He will have to do more than decide to subscribe or not to subscribe to a journal. If some of the methods the use of the computer suggests as possible are to be realized, the user must participate through a constant feedback loop which indicates the usefulness of the information he is receiving.

For example, we are actively considering methods for giving the scientist more selective access to the literature. We would hope to develop methods for keeping abreast of the scientist's changing needs, and the value of such methods in making decisions regarding the distribution of the literature. In effect, the computer is drawing together the primary publication function and the secondary or retrieval function. We will look to the user, also, to transfer to the proposed primary publication system some of the effort which he puts on retrieval.

The vision of scientists sitting at cathode ray consoles and getting information at the push of a button has been dangled before us, but some substance has been given to the vision through work going on now at the Massachusetts Institute of Technology. In this project, some 100 scientists and their colleagues are tied in to a time-sharing computer via Teletype keyboards. The store contains more than 40,000 articles from physics journals. By direct and real-time interaction, the scientist types a question

on his Teletype and, in response, receives answers to questions involving bibliographies, literature references, citations, author information, and similarly related items.

What these things mean to the future of the scientific periodical is far from clear. While we see the journal becoming more specialized and more flexible in its adaptability to the changing needs of the scientist, we think that reading in the form offered by the journal package will remain the prime factor in the distribution of scientific literature. We recognize the computer as a tool for helping do a better job, and we are in the process of learning to use it, but most of the progress lies ahead.

THE AUTHOR

Joseph H. Kuney received his B.S. degree in Chemistry at the University of Chicago and his M.A. degree in Communication at The American University. His experience includes 11 years in the printing and composing room. For the past 19 years he has been associated with the American Chemical Society, where he started as an Associate Editor in 1946 and is now the Director of Business Operations and Publications Research. Mr. Kuney is the author of many professional articles and reports.

Chapter 5

COMPUTERS IN BOOK COMPOSITION

ALAN S. HOLLIDAY

President, The Science Press, Inc.

I DISCLAIM all credit for being an expert. However, having been engaged in some form of composition in the Graphic Arts since 1945 and more recently with photocomposition at Science Press, I can say that I am aware of the problems that are created in the composition of a job especially with the elements of inadequate copy, inadequate equipment, and temperamental authors and publishers. Also, I might add that some personal research over the past three years in the field of computer composition has brought to full cycle my thinking that any problems inherent in the present hot or cold systems as now established will be increased, not decreased, by the application of the computer to any type of composition.

The word "book" is in itself deceptive. What is a book? To a professor of English, it may be a hard-bound volume setting down the rules for correct English usage. To a mathematician, it may be a soft-cover workbook setting forth the latest equations used in solving problems for a specific discipline. To a child, a comic book is a book. It was Gertrude Stein who said, "A rose is a rose is a rose." To many people we could paraphrase this quotation and say, "A book is a book is a book"—but is it?

The following is quoted from a paper presented at the Research and Engineering Council's International Computer Conference in Washington:

I read all available information concerning computerized type-setting. My opinion about a part of it is that it is light, touches only the high spots, ignores the chief problems, and that the purpose and intent of most of it is to glamorize automated type-setting. I believe that part of the material which floods the trade magazines on this subject is ill-advised, harmful to the trade as a whole, unreliable, undependable, and much of the information will not hold up when analyzed carefully.

The author of this paper stated that this was an opinion which he could not back up or prove with scientific studies. However, it is my own personal observation that the computer has been glamorized out of all proportion and that the romance engendered by the glamor has caused hardheaded businessmen, who would normally double- and triple-check the price of a spool of binding wire, to rush off, checkbook in hand, to the nearest computer supplier.

There may be some very good reasons for this attitude. The continued upward spiral of wages, the decrease in output of the individual worker, the demands for tighter schedules and the seemingly insatiable appetite of the reading public—all these reasons create pressures that send the hapless printing plant owner scurrying down any alley that holds a glimmer of hope.

Several ground rules must be established as a basis for exchanging meaningful information.

First, we must define what we mean by "book composition." Is it to be straight matter, as I define straight matter, or complex setting, directory work, straight listings, or matter containing chemical symbolism?

Secondly, we must identify the type of computer we are talking about. We have many choices from the simple, single-purpose computer to the highly sophisticated general-purpose machine which will do everything from simple arithmetic to the most complex job of information retrieval.

Thirdly, we must identify the equipment necessary to reproduce the material from computer-generated tape, and here again it may be the fairly simple line-casting machine or the hideously complex Zip or Lino-tron.

And last, but certainly not least, we must determine the economics of this entire system as we put it together.

In order to keep within my own assignment, I am confining my comments to simple, straight-matter setting; I will relate the output from a

simple, single-purpose computer through a fairly simple typesetting apparatus to the economics of that system.

Let us go back two years, when a major manufacturer of computer equipment made a study of the Graphic Arts and then put on a strong sales program to sell their specific system to the trade as an all-inclusive package from input through tape merging of corrections to formatting to computer output of a tape that would produce through a sophisticated photo-typesetter a complete page ready for camera. To the best of my knowledge the software necessary to implement this system has not been developed yet; or, if it has, the peripatetic gyrations of authors of books have created a situation that has short-circuited the computer and ruled out any savings.

With this as a base to operate from it seems to me that the sensible approach at this point is to take a tape that has been generated on any one of a number of typing units, unjustified and unhyphenated, and feed this information to a single-purpose computer which has the software within to produce a justified, hyphenated tape. The output from this system can be adaptable to either a line-casting machine or a high-speed photo-composition device. The product is a galley of material that can be pasted up, moved about and manipulated according to the aesthetic or esoteric desires of the author.

Speaking of the economics of computer composition for books, there has been much discussion at seminars and in the trade press lately relating to this matter. There appears to be a feeling that the input to the computer holds the key to a profitable or unprofitable operation. The actual number of key strokes necessary to create the characters to be produced and the key strokes necessary to input function signals to the computer in order to activate the typesetting device for various changes in type style, size, measure, etc., create the over-all cost and we cannot disregard any of these.

A chart showing the performance standards of two companies now perforating tape on teletypesetter units, justified and hyphenated, is shown in Tables I and II. The computer in use is a single-purpose LINASEC.

In all cases figures represent justified lines produced. Setting of unjustified lines would represent a 14.3% increase in productivity. If we use 35 words a minute as representing 12,000 key strokes per hour, the net gain on unjustified material would be five words a minute for a total of 40 words per minute.

I think it is fairly obvious that the sales literature that is being developed today on perforating equipment which states that 80 words per minute are possible is nothing less than wishful thinking. It is possible

Table I
Performance Standards of Company "A"

<i>Keystrokes per hour</i>	<i>Operator experience</i>	<i>Measure</i>	<i>Characters per line</i>	<i>Lines per hour</i>
6687	New	24 picas	64	187
12,717	9 months			
14,000	11 months			
8523	{ Less than one year	BOOK MATTER—NO MIXING—2% function codes figured in keystrokes		
8750	{ Less than one year			
9291	{ Less than one year			
7734	{ Less than one year			
9209	{ Less than one year			
10,199	{ Less than one year			
		12,408 Keystrokes Justified = 35 w.p.m.		
			Unjustified = 40 w.p.m.	

Table II
Performance Standards of Company "B"

<i>Keystrokes per hour</i>	<i>Operator experience</i>	<i>Measure</i>	<i>Characters per line</i>	<i>Lines per hour</i>
10,340	1 year	24 picas	64	161
9876	1 year			
11,234	1 year	In this case TTS Perforator plus Special-Purpose Perforators are being used.		
12,126	1 year			
		In this example standards set for operators were as follows:		
		4400 KSPH at end one month		
		7700 KSPH at end three months		
		10,000 KSPH at end one year		

that under ideal conditions for a brief period of time a highly motivated operator might produce these 80 w.p.m.; however, under sustained production the averages as developed by these two companies would appear to be normal.

About a year ago Science Press did a study to compare the time factors in producing certain book pages by tape input to the 200 Series Photon and straight keyboarding. The results may be of interest to you.

Table III
Photon Tape and Manual Keyboarding Comparison

<i>Object:</i> To analyze cost structure between production of type by LCC-S Friden input tape and keyboarding directly on the 200 Series Photon.		
<i>Scope:</i> Production figures for this analysis were obtained by running a special test which consisted of 10 pages of clean typewritten manuscript of absolutely straight text. This test produced 7½ normal book pages (27 x 42 picas).		
<i>Personnel:</i> The LCC-S machine was operated by a trained operator. She was a very fast and accurate typist who under sustained production could average 40 words per minute. The Photon operator was an extremely competent individual. Her last work was setting intricate mathematical formulas. She was not the fastest typist we had available.		
TIME ANALYSIS		
Operation	Manual Time (Photon)	Tape Perforation Time
Keyboarding	95 minutes	
Perforate Tape		75 minutes
Runoff Tape		73 minutes
Processing	12 minutes	12 minutes
Proof Reading	50 minutes	50 minutes
Correction Factors		
Setting*	6 minutes	7 minutes
Processing	6 minutes	6 minutes
Cutting in Corrections	12 minutes	10 minutes
Proof Checking	15 minutes	15 minutes
TOTAL TIME	3 hours 16 minutes	4 hours 8 minutes

* 12 errors on manual for ¾ galleys. 13 errors on tape for ¾ galleys.
Corrections for both conditions set at keyboard.

We applied some cost factors to the operations as listed on the time analysis. Without going into a detailed breakdown on each cost center, I can report that the manual cost was \$29.42 and the tape perforation cost \$30.89. Our cost per page figured out to \$3.92 manual keyboarding and \$4.11 with tape perforator.

Because of our experience with tape setting on Justowriter and Flexowriter equipment we made a study of the characters per line produced on the LCC-S. It was determined that because of the equipment used we

would not be able to get as tight a line, and as a result the number of pages for the entire job would increase by a factor of 18%. On this basis the cost of the job would be increased for composition as well as for preparatory, press, and binding operations.

As you can imagine, this is not a conclusive test. It did, however, give us some idea of what we might expect from a tape input to the 200 Series Photon.

There are one or two further statements from publishers I feel we should take into consideration in a further analysis of the cost of producing a book by the computer. On talking with some very large publishers of books, all of which are involved with the computer application, I have heard these comments:

The pagination routine developed by some computer centers and proposed by the large computer manufacturers is not commercially feasible costwise. (They cite no figures to support this.) One company states, "We are not now involved with the pagination routine because the software is not available." Another says, "Limitations of the software for pagination rules out any chance of it being economically successful as of this date."

Again: "The cost of developing our own software for pagination is too costly at this time." And again: "The core storage necessary for the hyphenation-justification routine is too limited on present computer equipment to include the pagination routine." And again: "Changes by author after pagination accomplished too costly to include as part of computer program."

It would seem from these comments that the ideal approach would be for the single-purpose computer to do just the hyphenation and justifying routine and let the product of the typesetting equipment be utilized as a paste-up for paging. Utilizing Xerox proofs or other proofing systems the author could dummy up and make changes as he now does with hot metal. However, a very large book publisher in the medical textbook field has stated: "If only the hyphenation and justification routine is the product of a computer-oriented book composition program it cannot be economically justified."

It may be helpful to review the process for producing a textbook by computer-oriented tape from a Linofilm machine with a partial pagination routine.

The program for this job was developed by a computer center. Because of the limitations of the Linofilm it was necessary to do a manual cast-

off. The running heads are set in 10 pt. and 8 pt. The Linofilm at the present time cannot mix two point sizes on the same line. In this job printout galleys were produced and proofs used by the production department to manually cast off the pages. Because of the numbers on the lines of computer printout, it was a relatively simple matter for the production man to mark out the number of lines, spacing, space for illustrations, etc. From that point the computer program was written to take all format instructions into consideration and, on the next pass through, the tape generated was suitable for conversion to a 15-level Linofilm input tape. With pages prepared by the Linofilm, the next step, of course, was to cut in the running heads and folios, drop illustrations and prepare the finished film positives for offset printing.

In summation, it would seem to me that a great deal more study is needed to justify anyone in running out and buying either a computer or a composing room. A great deal of further study is needed in the areas of input to the computer, cost of programs and output equipment.

Generally we can say that, for many applications to the publishing field, the computer is a blessing: information retrieval and storage, the compilation of lists, the single-purpose job where quality of production is not a factor. The problem, of course, is the utilization of input and output devices with the cost of computer time interposed.

Considering what we have developed in the line of input figures for the 200 Series Photon and the production figures of the two companies utilizing the TTS unjustifying machine with LINASEC, there would appear to me to be much more research needed in the field of costs for computer composition. Also within the last week we have heard from users of a computer system that they are breaking down the times for the input, computer passes and output on a one third each basis. That is, one third for input, one third for pass through, and one third for output.

If this is the case—and the people to whom we talked are leading in the field of computer evaluation for composition—then we feel that the one third computer time cannot make up for the other two thirds of input and output. Again we have heard all the arguments about machines not having to stop for coffee breaks, smoke breaks, etc. You are probably saying that this is a highly illogical or unanalytical statement and I must agree; but based on my earlier quotation from the speaker from the Research Council Conference and other statements concerning the profitability of computer composition, it adds another note of concern.

Personally, I favor the utilization of a computer center. Here trained computer personnel can take the problems of the printer and publisher and work out the routines necessary to produce the job that is needed.

Generally, computer people have a logical approach to problems that are sometimes glossed over by the printer and/or publisher. They can instruct us on the pitfalls and cost of our rigid thinking in the production of our work. They can also point out where we might modify our approach to utilize the benefits of the computer.

In all instances where I have talked to publishers they have a feeling for the future of book composition by the computer. They caution that the road will not be easy, that they will have to work closely with the author to have him accept some different procedures and results, but that once they can confine the elements of book production to a discipline which the computer understands, the rewards will be great.

I trust they are accurate. As printers we have a long road ahead of us to prove the economic feasibility of this new tool. As with the Linotype, the single revolution press, the web printing press and all the modern machinery the printing industry now has, it will take time, money, and no little effort. But I am confident that we will succeed and meet the demands of the publisher and the public.

THE AUTHOR

Alan S. Holliday attended Millersville State Teachers College before serving an apprenticeship with the Montrose Publishing Company. In 1948 he joined the Hughes Corporation as Compositor, advancing from Plant Superintendent to President of Craftsmen, Inc. At present he is President of The Science Press, Inc., a wholly owned subsidiary of the Printing Corporation of America. Mr. Holliday is also Past President of the Research & Engineering Council of the Graphic Arts Industry and of the International Association of Printing House Craftsmen.

Chapter 6

COMPUTER EXPERIENCE: DIRECTORY PRODUCTION

JOHN MARKUS
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A BUYERS' GUIDE type of directory presents a variety of unique publishing problems. These can best be understood by first seeing how a directory is produced conventionally. The example to be used is *Electronics Buyers' Guide*, the largest of all McGraw-Hill directories. This directory has two major parts—an alphabetized Manufacturers Section formatted as in Figure 1, and an alphabetized Product Section formatted as in Figure 2.

STEPS FOR CONVENTIONAL PRODUCTION

The main steps in producing a directory like this conventionally with hot-metal composition will be described first, to give a basis for evaluating computer techniques.

1. A questionnaire is sent out to all manufacturers, providing spaces for typing in the manufacturer's name, address, phone number, name of person to contact for information, number of employees, annual dollar volume of business, names of all

TELE.	MANUFACTURERS SALES/OR REPRESENTATIVES OFFICES	TEL. NO.
Fr	Sealol s.a.r.l., 79 Blvd. Gallieni, Issy-Les-Moulineaux (Seine).	MI 83-50
Ger	Sealol GmbH, 6238 Hofheim/Taunus, Lorsbacher Str	06192/7651
SEALS EASTERN INC. Box 250, Red Bank, NJ		747-9200
N Oranides #2 *25 150-205-752		
NY	Alex Dempster, Box 82, Elmwood Sta. Syracuse	
SEALTRON CORP. 188 Reading Rd. Cincinnati 15, Ohio		821-7444
K Neal #3 *75 E 205-220-470		
Cal	Hill-Rambo Assoc., 2526 Hyperion Ave. Los Angeles 27	664-2928
Cal	Cristee Meade Co., 6687 Hampton Dr. San Jose	266-5422
Conn	W McCoy & Co., 57 S Montwese St. Branford	488-3136
Ill	D Dolin Sales Co., 3553 W. Peterson Ave. Chicago 45	588-3738
Kan	Polynics Inc., 3802 B W 95th St. Leawood	N18-4173
Md	Daniel & Co., Box 124, Lutherville	825-3330
Mich	Component-Insulation Corp., 610 N Woodward, Birmingham	644-0087
Mo	Polynics Inc., 47 Village Sq. Shop Ctr. Hazlewood	7-0597
NJ	Robert Horne Assoc., 235 Wanaque Ave. Pompton Lakes	285-7409
NM	Bowden Engineering, 2633 Texas Ave. NE, Albuquerque	299-0473
Ohio	Component/Insulation Corp., 14235 Detroit Ave. Cleveland 7	521-3570
Pa	Daniel & Co., Box 133, Glenside	TW4-2130
Tex	Hillman Enterprises, 3505 Turtle Creek Blvd. Dallas 10	521-2070
Tex	Hillman Enterprises, Box 21, Georgetown	UN3-3780
Wis	Dave Dolin-Sales, 4962 N Hopkins, Milwaukee	464-4450
SECO ELECTRONICS DIV. DI ACRO CORP.		
1201 S Clover Dr. Minneapolis, Minn.		866-3477
J Bosiger #2 *50 D 225-250-385-415-560-675-875		
Cal	R L Stone Sales Co., 3600 Motor Ave. Los Angeles	UP0-5973
Cal	L H Harriss Co., 204 E Hillsdale Blvd. San Mateo	FL1-2909
Colo	Connors Inc., 2241 Stacey Dr., Denver 21	428-1575
Del	Carmine & Mullen Co., 14 Knickerbocker Dr. Newark	
Fla	Gartner Assoc., Inc., 235 Lincoln Rd. Miami Beach	531-0200
Ill	R D McAdaragh, 10718 S Wallace, Chicago 28	PU5-7955
Ill	Lyon Flaxman Co., 3553 W Peterson Ave. Chicago	539-5970
Mass	Harold A Chamberlin, Bedford Airport, Bedford	
Mo	Maury E Bettis Co., 3706 Broadway, Kansas City	L00-7722
NY	Cliff Landis Sales Co., 76-11 37th Ave. Jackson Hts. 72	IL8-7900
NC	Electro Rep Assoc., Inc., 1401 E 7th St. Charlotte	333-0451
Ohio	J W Lehner Co., 367 Brynhild Rd. Columbus	
Tex	Athans Sales Co., 2333 Farrington, Dallas 7	ME1-0520
Wash	Dave Miller Sales Co., 2323 N 45th St. Seattle 3	ME2-7070

Figure 1. Example of Manufacturers Section of 1964 *Electronics Buyers' Guide*, as previously produced by sequential card camera techniques. Code numbers at end of manufacturer entry were dropped in 1965.

representatives throughout the world, and names of all products made.

2. The returned questionnaires are carefully checked, then edited to a uniform abbreviating style.
3. Questionnaires are sent to the printer for setting into slugs of type, with the manufacturer's name and address being repeated once for each product made. For a large company like General Electric, this could involve repetition of identical name and address lines as many as 150 times.
4. The manufacturer data, including representatives, is arranged in alphabetical sequence by moving the slugs of type.

ELECTRONIC and ALLIED PRODUCTS

TUBES—ELECTROSTATIC PRINTING

Anglo Corp.4333 N. Ravenswood Ave. Chicago 13Ill
 Atomic Labs. Inc.3100 Crow Canyon Rd. San RamonCal
 Dumont Labs. Divs. Fairchild Cam. & Inst. Corp. (Electr. Tubes)
 750 Bloomfield Ave. CliftonNJ
 International Electronics Corp. (Mullard)
 81 Spring St. New York 12NY
 MED Electronics Inc.102 W. Jefferson St. Falls ChurchVa
 Raytheon Co. Ind. Components Div.
 55 Chapel St. Newton 58Mass
 Sylvania Elec. Prods. Inc. Electronic Tube Div.Seneca Falls .NY
 Victoreen Instrument Co.5806 Hough Ave. Cleveland 3Ohio

TUBES—GLOW OR DISCHARGE

A. COLD-CATHODE B. COLD-CATHODE TRIGGER
 C. HOT-CATHODE

Aerolux Light Corp.653 11th Ave. New York 36NY A B C
 Amark Corp.92 North Ave. New RochelleNY A B
 American Elite, Inc. (Telefunken)48-50 34 St. LIC 1NY A
 Anglo Corp.4333 N. Ravenswood Ave. Chicago 13Ill A B

AMPEREX ELECTRONIC CORP.

230 Duffy Ave. HicksvilleNY A B
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Baird-Atomic Inc.33 University Rd. Cambridge 38Mass A B
 Burroughs Corp. Electr. Comps. Div.Box 1226, PlainfieldNJ A
 Calvert Electronics Inc.

220 E. 23 St. Dept. EBG, New York 10NY A B
 Cerberus AGMannedorfSwitzerland A B
 EON Corp.175 Pearl St. Brooklyn 1NY A B
 Edgerton, Germeshausen & Grier, Inc.

160 Brookline Ave. BostonMass A B C
 Electro-Mite Div. York Res. Corp.1 Research Dr. Stamford .Conn A B C
 Elesta Ltd. ElectronicsBad RagazSwitzerland A B
 English Electric Valve Co. Ltd.Chelmsford EssexEng A B
 FUJITSU LTD.

6, 5-chome, Shiba Tamura-cho, Minato-ku, TokyoJap A
 Adv Pg 38

International Electronics Corp. (Mullard)
 81 Spring St. New York 12NY

MITSUBISHI ELECTRIC CORP.

2-12 Marunouchi, TokyoJap

MULLARD OVERSEAS, LTD.Torrington Pl. London, WC 1 .Eng

National Electronics, Inc.628 North St. GenevaIll

Radio Corp. of America, Electronic Components & Devices

415 S. Fifth St. HarrisonNJ

Thor Electronics Corp.287 Morris Ave. ElizabethNJ

TOKYO SHIBAURA ELECTRIC CO. LTD.

Hibiya Mitsui Bldg. Yuraku-cho, TokyoJap

Westinghouse Electric Corp. Electronic Tube Div.

Box 284, ElmiraNY

TUBES—IMAGE CONVERTER

See Also TUBES—CATHODE-RAY, TV
 CAMERA

Machlett Labs. Inc.1063 Hope St. SpringfieldConn

TUBES—IONIZATION See CHAMBERS—IONIZATION

TUBES—MICROWAVE

A. BACKWARD-WAVE (Incl. D. MAGNETRON, VOLTAGE-
 CARCINOTRON) TUNABLE
 B. KLYSTRON E. TRAVELING WAVE
 C. MAGNETRON F. CROSSED-FILED (EXCEPT
 MAGNETRON)

American Elite, Inc. (Telefunken)48-50 34 St. LIC 1NY B C E

American Radio Co. Inc.445 Park Ave. New York 22NY A

AMPEREX ELECTRONIC CORP.

230 Duffy Ave. HicksvilleNY B C E

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Beam Tube Corp.11 Beach St. MilfordMass B

Figure 2. Example of Product Section of 1964 *Electronics Buyers' Guide*. Product subdivision codes were changed to independent headings for the 1965 computer-based edition.

- Product headings are set in type, and the extra manufacturer name and address slugs are placed in alphabetical sequence under the headings of the products made by that manufacturer.
- When a manufacturer decides to advertise in the directory, part or all of his entries under the product headings are reset in bold-face type, and the page number of the advertisement is added.

Hot-metal composition is thus a strictly manual operation, with a great deal of repetitive keyboarding, and with many chances for human errors. These drawbacks have led many directory publishers to change to sequential card techniques, involving cameras like the Fotolist and Listomatic.

Here each line of the directory is typed in a precise position on an individual IBM card, using either a Varityper line composer or an electric typewriter with a special card-holding platen. The same amount of keyboarding is required as with hot metal, and the cards must still be retyped in bold-face type when advertising comes in, but now the typing can be started just as soon as a questionnaire is edited. The typed cards are sorted manually into the desired sequence and placed under the correct product headings. Alternatively, the cards can be keypunched with code numbers and sorted by machine. The sorted cards are then run through the camera. There are still plenty of possibilities for human errors in manual sorting of the cards, as well as keypunch errors that affect machine sorting. The sample pages in Figures 1 and 2 were produced by this sequential card technique.

ADVANTAGES OF COMPUTER

A computer can offer tempting economic advantages for directory composition. Here are ten reasons why:

1. A computer can use its data-processing capabilities for alphabetizing of names or sorting into code number sequence.
2. A computer can repeat a manufacturer's name and address automatically, under each heading for products made by that manufacturer.
3. A computer can detect and reject many types of errors in input keyboarding, particularly in code numbers for manufacturers and products.
4. A computer can convert code numbers to equivalent text, once it has been fed a master list for its dictionary lookup. This alone gives a tremendous reduction in keyboarding, particularly for making corrections and changes in current and future editions.
5. A computer can automatically change a manufacturer's listing to bold-face type, under some or all of his product headings, when that manufacturer becomes an advertiser, and insert the page number of the ad.
6. A computer can furnish the control codes needed for changing type font and size, indenting, and inserting extra space between listings. In other words, the computer can create the format of the directory automatically, if the input is appropriately divided into numbered fields.

7. A computer can insert repetitive words, phrases, and characters automatically, whenever they occur in fixed positions in a field.
8. A computer can calculate the positions of leader dots, so they line up vertically while filling out the space between material at the left and right of a line.
9. A computer can make last-minute changes in a manufacturer's corporate name or address automatically, wherever the name appears, if called for by a corporate move or merger.
10. A computer can reverse its work after the directory is completed, to produce customized questionnaires that are sent to the manufacturers next year. Each manufacturer then marks the changes desired. Only the fields having changes (such as a phone-number field or a product code number field) need to be input for the next directory.

These are some of the reasons why McGraw-Hill chose to process its largest directory—the *Electronics Buyers' Guide*—this year on one of its own computers. Actual values make the economic advantages even clearer. In 1965, the text for approximately 300 pages, consisting of the Manufacturers Section and the code numbers for the products made by each manufacturer, was keyboarded manually on tape-punching typewriters. This involved 4.9 million characters on eight miles of paper tape. A computer exploded this input to create another 500 pages of composition for the Product Section, with no additional keyboarding.

Once the input copy has been punched on paper tape, proofread from hard copy and from line printer proofs, and corrected, the job is just about done as far as humans are concerned. The computer does the rest. The additional 500 pages of composition generated by the computer do not have to be proofread completely. The final repro positives of the photocomposition machines need only be scanned quickly for uniform density of exposure, because we have now eliminated machine errors for all practical purposes.

The chart in Figure 3 gives a quick overview of the entire computer-based production process. The four types of inputs are punched on paper tape and fed into the computer for processing. New punched paper tapes come out of the computer, to drive the phototypesetter that makes the repro positives from which the final offset printing plates are made for the directory.

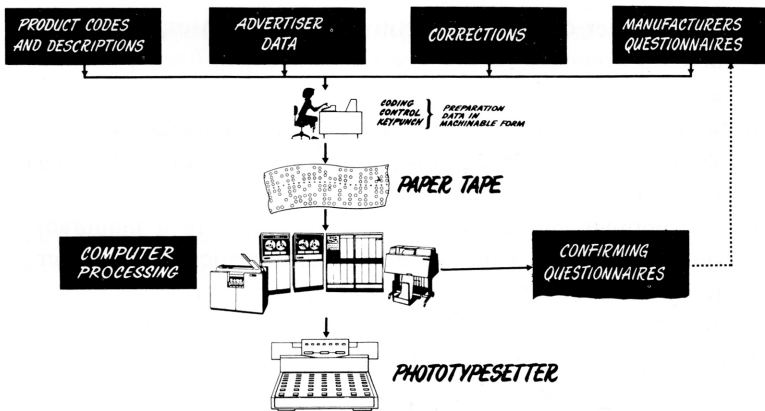


Figure 3. Flow chart for computer production of directory. The repro proofs produced on photographic paper by the phototypesetter are used to produce printing plates for *Electronics Buyers' Guide*.

STEPS FOR COMPUTERIZED PRODUCTION

Since there was no precedent for producing a directory of this size and type by computer, many decisions had to be made in conjunction with an exhaustive systems study. While describing the procedures finally adopted, the problems and options will be covered for guidance in planning similar jobs. Here are the main steps:

1. Prepare detailed specifications for the exact typography and format desired. This job is much bigger than it sounds. Rules must be established for each and every detail of type size, style, special characters, punctuation, indents, capitalization, handling of turnover lines, column widths, spacing between lines, leader dots, rules for breaking an address when it will not all go on one line, etc. The entire input must be divided into logical fields, and the maximum number of characters in each field must be specified. The importance of doing this beforehand cannot be emphasized too much, because changes in computer programming can be very costly.

2. Assign code numbers to manufacturers and products. This is done to reduce keyboarding and permit alphabetic sequencing within the computer by sorting on a minimum number of numeric digits. Our 7,000 manufacturer names were manually alphabetized first, punched on paper tape, then fed into a computer for automatic assignment of six-digit code numbers with a spacing of 125 between the numbers. This permits insertion of new names in correct alphabetic sequence in future years. Each new name is given a number halfway between the numbers of adjacent

names, to leave room for inserting further names. Product headings are similarly tape-punched and given five-digit codes.

When assigning codes, the computer also adds a check digit at the end of each number, to permit automatic computer detection of errors in typing of code numbers. The method of doing this is shown in Figure 4. If an error is made in a code number, the computer will get a different check digit and thus detect the error.

3. Design the data-acquisition questionnaires with the aid of computer programmers, to insure that the data furnished by some 7,000 manufacturers will be in the most convenient form for transferring accurately to punched paper tape. The questionnaire should include field codes, so typists have an absolute minimum of rules to remember. We used a numeral and a period to identify and separate the fields, as shown in Figure 5.

The questionnaire contains spaces for writing in the code numbers of the products made. The manufacturer first locates and marks his products in the booklet inside the questionnaire (Figure 6), then transfers the numbers of his products to the sheet that is returned.

4. Print manufacturer addresses on self-adhesive labels mounted on sprocketed computer line-printer paper, with the manufacturer code number on each label, then peel off these labels and place them on the printed questionnaires, in correct position to be seen through the window of the mailing envelope. This insures that the manufacturer's code number will come back with the questionnaire, and eliminates the need for retyping of the manufacturer's name and address unless there are changes.

5. Check questionnaires carefully when they come back, and edit and abbreviate for consistency of style in addresses. This step is necessary and important, because no matter how carefully a questionnaire is designed, there will still be people who fail to follow instructions. Over 5,000 questionnaires were returned (70% of those sent out).

$$\begin{array}{r}
 \begin{array}{cccccc}
 2 & 1 & 6 & 5 & 0 & 7 \\
 \times 2 & \times 1 & \times 2 & \times 1 & \times 2 & \\
 \hline
 4 & +1 & +1+2 & +5 & +0 & = 13 \\
 & & & & & 20 - 13 = 7
 \end{array}
 \end{array}$$

Figure 4. Method of computing check digit for product code 21650 in computer. Each number is multiplied alternately by 2 and 1, the products are added (treating 12 as 1+2), and the sum is subtracted from the next higher multiple of 10 to get the check digit.

FOR RETURN SELF MAILER, FOLD 1ST PANEL BACK AND TURN THIS GUMMED FLAP DOWN AND SEAL

1965 Electronics BUYERS' GUIDE

Questionnaire and Answer Form

7 Telephone Number		8 No. of Employees (EMP)		9 No. of Engineers (ENG)		FOR CORRECTION OF COMPANY NAME & ADDRESS	
A		DOLLAR VOLUME (Circle letter only)		10		1 Company Name	
B		A Up to \$100,000 per year		E \$1,000,001 to \$2,500,000 per year		2 Street Address	
		B \$100,001 to \$250,000 per year		F \$2,500,001 to \$5,000,000 per year		3 City	
		C \$250,001 to \$500,000 per year		G \$5,000,001 to \$10,000,000 per year		5 County	
		D \$500,001 to \$1,000,000 per year		H Over \$10,000,000 per year		4 State	
						6 Zip Code	
C		11		Check Box ☐ if using a keyed address			
		President's Name (Pres)					
		Sales Manager (Sls Mgr)					
D		12 LIST PRODUCT NUMBERS ONLY IN NUMERICAL ORDER BY COLUMNS (Type or Print Clearly)					
*							
		LIST SALES OFFICES / MANUFACTURERS' REPRESENTATIVES. DO NOT LIST DISTRIBUTORS OR DEALERS. If you have more than one office in a state, cross out the name of the state in an unused blank above or below.					
E		13 Territory		14 Sales Office / Manufacturers' Representative		15 Street Address	
		Alabama 01				City	
		Alaska 02				Telephone Number	
		Sweden 83					
		Switzerland 64					

Figure 5. Method of preprinting field-identifying numerals, code letters representing dollar volume, and numeric territory codes. Actual questionnaire is 37" long, fits into typewriter, and folds so it can be sealed with business reply indicia and return address (printed on back) showing.

300756—Facsimile Equipment— Transmitters Fans See Blowers	314757—Fixtures, Holding— Printed Wiring Boards Flanges—Waveguide See Waveguide Flanges	328005—Fungiproofing Services
301259—Fasteners & Fastening Devices Fathometers See Depth Sounders Fault Locators See Locators—Cable & Line Fault Feed-Through Capacitors See Capacitors—Fixed Ferrite Aperture Plates See Memories—Computer Ferrite Core Plates See Memories—Computer Ferrite Cores See Cores— Molded Magnetic Ferrite Isolators See Isolators Ferrite Magnets See Magnets—Permanent Ferrite Modulators See Modulators Ferrite-Rod Antennas See Antennas—Radio Receiving	315259—Flashers Flexible Shafts See Shafts—Flexible Flight Simulators See Simulators 316000—Flowmeters See Also Indicators—Fluid Flow 316257—Fluorescent Compounds— Phosphors Fluorocarbons See Plastics 316752—Fluxes 317008—Fluxes—Brazing 317255—Fluxes—Soldering, Lead- Tin, Acid 317503—Fluxes—Soldering, Lead- Tin, Noncorrosive 317750—Fluxes—Soldering, Silver 318006—Fluxmeters Flyback Transformers See Transformers Special F-M Amplifiers See Amplifiers—R-F Preamplifiers	328252—Furnaces—Controlled Atmosphere 328500—Furnaces—Diffusion 328757—Furnaces—Electric (for Component production) 329003—Furnaces—Gas Fired (for Component production) 329250—Furnaces—High Frequency 329508—Furnaces—Vacuum Fuse Blocks See Holders— Fuse Fuse Holders See Holders 330258—Fuses—Current Limiting 330506—Fuses—Standard 330753—Fuses—Thin Film 331009—Fuses—Time Delay 331256—Fuses—Wire 331504—Fuses, Electronic— Proximity 331751—Fuses, Electronic— Time
304006—Ferrites—Raw Material See Also Garnet		
304253—Fiber Optics Equipment & Components		
304501—Fibers—Optical		

Figure 6. Method of showing code numbers for products in booklet that accompanies questionnaire.

6. Select input hardware. The input to the computer can be either punched paper tape or magnetic tape produced by an electronic character reader such as the Farrington scanner. There are two types of paper tape machines—those used in newspaper and printing plants, which do not provide hard copy, and typewriter-controlled punches.

We ruled out the newspaper machines because we wanted hard copies for proofreading and wanted to use ordinary typists. We ruled out the scanner because our Farrington machine could read only caps. The use of special codes to indicate shift and unshift would have slowed up typing and made proofreading difficult.

The choice between the Dura Mach 10 and the Friden Flexowriter was more difficult. The Dura was finally selected because its IBM Selectric bouncing-ball typewriter permitted higher typing speeds. On the Dura, shift and unshift codes are punched automatically when the typist hits the conventional shift keys, whereas on the Friden the shift code must be punched separately by the operator. Unfortunately, we found that the Dura occasionally lost a shift code when typists were allowed to type at their maximum speed, and we had to slow them down. Our conclusion is that there is as yet no ideal input machine for computer composition.

7. Choose a computer. Not all computers can perform the same functions. For example, only computers equipped with a number of magnetic tape units can sort directory data effectively, and only computers equipped with line printers can produce hard copy for proofreading. Likewise, the paper tape readers and punches required for handling composition are not standard equipment on all computers. For this reason, a choice of a specific computer can be made only after all of the processing operations have been identified. This will probably lead to a choice of several different models of computers, each of which perhaps could perform the job effectively. We in McGraw-Hill chose the Honeywell 200, because it was available in our data center and fulfilled all of the requirements for computer composition.

8. Select programmers. For most people, there will be a choice between in-house programmers and an outside programming firm having previous experience in programming for computer composition. We chose an outside firm, National Computer Analysts in Princeton, N.J., just a few miles from our computer center in Hightstown.

9. Choose the type of programming desired. Variable-length programming is almost an essential for computer composition of directories, so we chose that initially. After about a month of programming, it was found that the required Honeywell software for this would not be available in time. As a consequence, we had to change over to fixed-field pro-

gramming, which will make our computer processing runs take almost four times as long.

10. Choose an output machine. We ruled out hot metal immediately because all existing machines have an inherent mechanical error rate of at least 2%, which would mean rekeyboarding and recasting one slug in 50, and would require careful proofreading of the entire output. Photo-composition machines have a much better accuracy rate, approaching perfection. Here, however, the choice for our job was narrowed down to just one machine, the American Type Founders B-8, which is reliable even though painfully slow. The slowness is an asset, however, because the four machines available to us provide backup for each other in the event of trouble. We did need to have special 176-character type disks made, in order to get the variety of type fonts and sizes required. The fonts used are shown in Figure 7.

11. Punch the input, working directly from the questionnaires. We farmed out this input punching to the programming firm, to achieve single responsibility. Here it was found that the hard copy did not always correspond to the punches in the tape. Accordingly, the punched tape was fed back into the reader of the Dura to produce new hard copy that corresponded exactly to the tape. Among other things, this revealed missing shift codes.

12. Proofread the hard copy against the questionnaires conventionally.

CONTINENTAL SCREW CO,
459 SOUTH MT PLEASANT ST, DEPT JA,
NEW BEDFORD, MASS 12345 993-2621
D SLEEPER, PRES, 10 EMP, 2 ENG, \$400M-750M

DUMONT LABS, DIVS FAIRCHILD CAM & INST CORP.
ELECTRO-VISUAL DEPT, MOBILE COMMUNICATIONS
750 BLOOMFIELD AVE, CLIFTON, NJ 12345 773-2000
E ALLEN, SLS MGR, 75 EMP, 3 ENG, \$2,500M-5,000M

Cal DuMont Labs, 11800 W Olympic Blvd, 478-0806
W Los Angeles
Ohio DuMont Labs, 8905 Lake Ave, Cleveland 651-2360
Tex DuMont Labs, Braniff Bldg Exch Pk Ctr, FL1-6842
Dallas

GENERAL PRECISION INC, AEROSPACE GR, KEARFOTT
DIV, SYS DIV,
115 MCBRIDE AVE, LITTLE FALLS, NJ 12345 256-4000
G TOKER, SLS MGR, 15 EMP, 1 ENG, \$500M-750M

Ala McConnell Sales & Engr Corp, Box 5825, TR1-3501
Birmingham 9
Cal Shand & Jurs Co, 2600 8th St, Berkeley 10 848-2345
Cal Bojanower Machine Serv Co, AN3-6175
5270 E Washington Blvd, Los Angeles
Cal Shand & Jurs Co, 6399 Wilshire Blvd, 653-0424
Los Angeles
Cal Bojanower Mach Serv Co, 150 Cerrito Ave, EM6-5432
Redwood City
Cal W H Neville Corp, Box 2306, Riverside 684-0718

CABLE ASSEMBLIES (WITH CONNECTORS) See Also HARNESSSES ASSEMBLY HARNESSSES

HEWLETT-PACKARD CO, 1501 PAGE MILL ROAD,
PALO ALTO, CAL 12345
ADV PG 252, 253, 476, 477, 480, 481

POLARAD ELECTRONIC INSTRUMENTS DIV,
34-02 QUEENS BLVD, LONG ISLAND CITY, NY 12345
ADV PG 227-229, 233

WESTON INSTRUMENTS & ELECTRONIC DIV,
DAYSTROM, INC, 614 FRELINGHUYSEN AVE,
NEWARK, NJ 12345 ADV PG 272, 273

Aerospace Research Inc, 130 Lincoln St, Mass
Boston 35
Applied Magnetics Corp, 749 S Kellogg Ave, Cal
Goleta
Astronetic Research Inc, PO Drawer B, Nashua NH
Atlantic Research Corp, Shirley Hwy @ Edsall Rd, Va
Alexandria
Canadian Research Institute, 85 Curfew Dr, Ont
Don Mills
Chemalloy Electronics Corp, 7947 John Towers Ave, Cal
Santee
Chesapeake Instrument Corp, Shadyside Md
de Havilland Aircraft of Canada Ltd, Spec Prods
& Appl Res Div, Malton Ont
Dresser Controls Div, Dresser Industries, Box 2726, Tex
Houston

Figure 7. Example of final typography selected for 1965 *Electronics Buyers' Guide*, consisting of 6-point News Gothic Condensed caps and lower case, 6-point Alternate Number 2 caps, and 8-point Spartan Heavy, on special ATF disk.

13. Punch correction tapes for the errors. This involves simply punching the manufacturer code, the field number, and the new field desired. With our system, the average length of a field is about three words.

14. Feed batches of punched tape into the computer, along with the correction tapes, for converting to magnetic tape at 500 characters per second and merging of corrections. At this time, the computer makes validity checks of code numbers, and counts characters to make sure no field is longer than the maximum length provided for it.

15. Produce line printer proofs of the input. Since line printers, with one IBM exception that we did not have, can print only capital letters, some means of identifying the true capital letters had to be used. Several possible ways of doing this are shown in Figure 8. We chose the last method, in which an open lozenge is printed under each true capital letter. This decision has worked out very well from the proofreading standpoint, even though it does double the line printer running time.

The first line printer proof from the computer is shown in Figure 9. Here the parentheses around field numbers were added by the computer for the benefit of proofreaders. The spacing and positioning of fields on the printout is similarly designed to make proofreading easy.

The computer stores records of all errors it has detected and makes a special printout of these. The only error not accepted by the computer is an error in the manufacturer code number. When one of these is found, as a result of the check digit, the computer punches out the entire record

```

@METABOLIC DISTURBANCES, FAVORABLE RESULTS CANNOT BE EXPECTED.
@%COMBINATION OF EXTRAPERITONIZATION OF THE RIGHT LOBE OF THE
@LIVER HAS BEEN COMBINED WITH A TERMINOLATERAL PORTACAVAL
@SHUNT IN 2 PATIENTS, A WOMAN, AND A MAN, 54, WHO, AFTER 6
@MONTHS AND 2 YEARS, RESPECTIVELY, ARE IN GOOD GENERAL CONDI-
@TION, WITH COMPLETE ABSENCE OF ASCITES AND QUITE SATISFACTORY
@HEPATIC IFUNCTION.33/

<B>ABCOCK <7 W>ILCOX <O>O <R>EFACTORIES <D>IV
<M>R <M J T>ERMAN, <M>KTG <M>GR 161 <E >42ND <S>T
<N>EW <Y>ORK 17 CN Y

<B>ACON <I>NDUSTRIES, <I>ND
<M>R <E>LDON <H F>AY, <S>ALES <M>GR 192 <P>LEASANT <S>T
<W>ATERTOWN 72 CM>ASS

*1234567 *DUMONT LABS, DIVS FAIRCHILD CAM & INST CORP, ELECTRO-VISUAL DEPT, M
*750 BLOOMFIELD AVE *CLIFTON
*SLS MGR F ALLEN *829-4694 *000075

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Figure 8. Three methods of indicating capitalization on line printer proofs. Top: Percent sign indicates shift to caps, and open lozenge indicates shift back to lower case. Center: Lesser-than sign indicates shift to caps, and greater-than sign indicates shift back to lower case. Bottom: Line printer is double spaced, and open lozenge is placed under each capital letter.

In printing terminology, our column width is 200 units of 6-point type, which comes out to be 14.1527 picas. Character widths are specified to thirds of a unit, so each line is made up of 600 increments. To make leader dots line up vertically, the computer is programmed to start them only at fixed positions. This means that there are slightly different spaces on each side of a string of leader dots, calculated exactly by the computer and placed in the output punched tape.

To avoid awkward splitting of such fields as a street address at the end of the line, the computer is told that if any part of a field will not fit on a line, the entire field must be moved to the next line. This does not look too bad, as you can see from the typography sample in Figure 7. By using leader dots to make phone numbers and ad page numbers come out flush right, we get the illusion of justification without going to the more complicated computer programming required for hyphenating and justifying.

The Manufacturers Section is produced first, since it is independent of advertising. Processing of this takes only a few hours of time on the Honeywell 200, but we must tie up the computer for 21 hours to drive its 110-character-per-second output punch to produce 63 reels of 8-channel paper tape for the ATF machines. Off-line converters are made for this purpose, admittedly, but they are expensive and not readily available. For this first job it was better for us to use the computer as its own mag-to-paper-tape converter.

19. Punch output tapes for the Product Section. This involves even trickier data-processing, a few weeks later. Here the computer must place each manufacturer under the heading for each product made by that manufacturer—the advertisers coming first, in bold-face type in their own alpha sequence, followed by nonadvertisers in light-face type in another alpha sequence.

In addition, when an advertiser uses special insert ads, the computer leaves room for a one-inch ad that calls attention to the advertising pages of that firm in the insert section. If our output machine had more type faces, the computer could even generate these one-inch ads.

Again, we have only a few hours of processing runs on the computer, followed by about 35 hours for driving the output punch.

20. Expose photographic paper to obtain repro positives. The ATF B-8 machines run at about 5 characters per second, which is just about the speed of an average typist. We estimate that there will be about 28 miles of paper tape to run through these machines. With one machine held in reserve for backup, the three machines running two shifts will turn out the repro positives for both sections in about 20 days.

Two Xerox copies are made of the repros. One is for a final quick

proofreading. The other is used for preparing rough page layouts on which the positions of fractional ads will be shown. Repro proofs and ad proofs will then be cut up and dummied precisely on drawing boards, to get final pages that will be photographed by the offset plate maker.

WHAT HAPPENS NEXT YEAR

The magnetic tape reels containing the input data will be stored, for use next year in producing individual questionnaires for each manufacturer, with addresses in correct positions for window envelopes. These customized questionnaires will make it easy for manufacturers to check what they had last year, so they can mark the changes desired. After the first year, it is estimated that only about 50 pages of input will be keyboarded to get 800 pages of output.

Our directory program has been written in a modular form, to permit easy modification for handling other product directories having slightly different formats. It is also hoped that this same program will serve for processing magazine and book indexes, since these involve a similar repetition of an entry in alphabetized sequence under a number of different headings.

The task of preparing by computer the 1965 edition of the *Electronics Buyers' Guide* took the experience and time of many individuals in and outside of McGraw-Hill. These include the manufacturers of the data-processing equipment used, the management of *Electronics* magazine, and the managers and associates in our Manufacturing, Illustration, and Data Processing Divisions.

We do see a bright future for computer composition of directories and indexes.

THE AUTHOR

John Markus has been the Manager of Information Research of McGraw-Hill, Inc., in New York since 1960. He received his B.S. degree in Electrical Engineering from the University of Minnesota in 1933. From 1943–1960 Mr. Markus was the feature editor of the magazine *Electronics* and is also the author, co-author or editor of 14 McGraw-Hill books. He is a member of the Editorial Board of *American Documentation* as well as a member of the Advisory Committee of the Annual Review of Information Science and Technology.

Chapter 7

EXPERIENCE WITH THE GRACE SYSTEM¹

CHARLES J. AUSTIN
National Library of Medicine
Bethesda, Md.

MY PURPOSE is to describe an operating system at the National Library of Medicine which uses computer phototypesetting equipment.

The National Library of Medicine has a long history of bibliographic publication. The first issue of the *Index Medicus*, our primary publication, was initiated by Dr. John Shaw Billings in 1879, and medical libraries throughout the world still make use of this early work. The Library has produced and published indexes and catalogs of the medical literature ever since. The production of these publications has been accomplished by various methods throughout the years. I will mention the last three systems that have been used for publication and typographic work.

The predecessor publication to the current *Index Medicus* was called the *Current List of Medical Literature*. It was produced by typing citations onto sets of 3 x 5 cards which were then pasted up, photographed, and reduced. This system was in use from July 1950 through December 1959.

¹ The report is based on work performed in a U.S. Government Agency. It is, therefore, exempt from copyright restriction and in the public domain.

In 1958 the Library realized that more modern procedures had to be introduced to keep up with the growing size of the publication. A system was developed using a Listomatic camera to arrange typed text for printing. This particular system involved the typing of a citation on an IBM card in a special area at the top of the card. Additional control information was key-punched into the card for sorting and collating purposes. At the end of the month, these cards were sorted and merged with master file and header information, and run through the Listomatic camera. The camera produced a continuous roll of film which was cut into column lengths. Three columns to a page were taped together on a special device made up for this purpose.

This system worked well from 1960 through 1963. However, the Library desired to develop a mechanized search function and to expand its bibliographic products to others besides the printed *Index Medicus*. For these purposes, the computer-based system which we call MEDLARS (Medical Literature Analysis and Retrieval System) was created in 1961.

MEDLARS was designed for three major purposes. The publication of current indexes to the medical literature was certainly one of the primary objectives of this system. In addition to preparing the *Index Medicus*, a monthly listing of some 14,000 new articles in the medical field with an annual cumulation running into four volumes, the system was also designed for the preparation of other bibliographic products in more specialized subject fields such as rheumatology, dentistry, heart disease, etc.

The third objective of the system was information retrieval. I will not dwell on this, other than to point out that we are searching, by means of computer, a very large file of citations on tape, currently consisting of about 300,000 articles. The file is updated with some 700 new references each day. The results of demand searches, which are run for individuals in answer to specific reference questions, are printed out on the computer printer. I mention the search and retrieval aspect to make it clear that the purpose of installing the equipment we are discussing here, particularly the computer, was to permit machine retrieval as well as publication.

DEVELOPMENT OF THE GRACE EQUIPMENT

When the system was initially designed, part of the specification task was to define the output requirements. It was decided quite early that an expanded character set would be required, over and above what is available on a standard computer printer with 48 to 56 characters. The Library decided that it was important that the system be able to deliver characters for publications in upper and lower case, and, if possible, in different point sizes. Quality of print was important, and there was a

definite requirement for volume reproduction. There are 6,827 copies of the monthly issues of *Index Medicus* being printed.

Along with these requirements for an expanded character set and a typographically pleasing publication was the desire to minimize the page requirements for each issue. A monthly issue of *Index Medicus* runs between six and seven hundred pages. At the end of the year these are cumulated into a four-volume set of over 6,000 pages. We also wanted to minimize the amount of time required from the final cut-off of input at the end of the month until copy was ready to be delivered to the printer.

MEDLARS was developed under contract by the General Electric Company's Information Systems Operation, which prepared most of the detailed specifications for the system's magnetic-tape-driven phototypesetter. Before it was decided to enter into this venture, alternatives were considered in the design phase of the project. These included the use of paper-tape-driven typesetters, computer printers with an expanded character set to meet at least the minimum requirements of upper and lower case letters, the use of paper tape typewriters—Justowriters, Flexowriters, or other machines of this type—and, finally, manual typesetting of manuscript copy produced by computer. Manual typesetting had to be rejected early because of the importance of the throughput requirements in the system.

All of these alternatives were considered in terms of throughput times, quality, page requirements, and other factors. The Library decided that nothing commercially available at that time (1961) would satisfactorily meet the requirements. A decision was made to support the development of a new phototypesetter that would operate at magnetic tape speeds.

The General Electric Company team went to work on the development of the detailed specifications for this equipment. First, a requirement for speed was set. The initial specification called for a minimum speed of 2.5 lines of type composed per second. This requirement was not met. The operating speed of the equipment is actually 1.7 lines per second. The character set was specified in detail, as were the physical size of the equipment, performance requirements, minimum allowable error rates, and various special features.

These specifications then were opened for bidding, and an award was made to the Photon Corporation for construction of the machine which we call GRACE—Graphic Arts Composing Equipment. The contract was awarded on August 1, 1962, and the fabrication period at the Photon factory began immediately thereafter. The first phase dealt with design and creation of "breadboard" models of the various components. Then the process moved into manufacture and assembly and finally factory test-

ing, which began in February 1964. The equipment was delivered in May 1964, approximately one year later than scheduled.

Because of this delay, the Library went into production in January 1964 producing the *Index Medicus* by computer printer. The first six issues of the 1964 publication were produced on a Honeywell line printer, which we slowed down from the normal 900 lines a minute to 600 lines a minute in order to achieve high quality. The computer output was photo-reduced to approximately 60 percent of original size.

In order to develop a better backup for the GRACE equipment after delivery, we decided to reprogram this computer printer output system to utilize an IBM 1403 line printer with upper and lower case characters. The July 1964 issue was produced on the 1403.

GRACE INSTALLATION

The equipment was installed in May 1964 and we began a period of acceptance testing. The tests included production of three complete issues of *Index Medicus*, plus a cumulation of these issues. Several other publications were also run during the testing period.

For the 30-day acceptance test period the equipment was used a total of 144 hours. The machine was down for 15 hours, and the uptime was 90.8%. Before we entered into the period of system testing, there were further negotiations on the original specifications and one of the things we agreed to was lowering of the speed as mentioned above.

Production with the equipment began with the August 1964 issue of *Index Medicus*, and has continued regularly since then.

The character set for GRACE consists of 226 printing characters. A special eight-bit code is used for each of these characters. The other 30 possibilities from the eight bits are taken up with blank spaces of varying widths and control characters related to the software requirements of the system. The output medium is positive film or paper in rolls 9" x 120'. The speed of the equipment is 1.7 lines per second, which in our normal publications employing a basic six-point font will yield about 300 characters a second. A full page of three-column *Index Medicus* text takes approximately one minute to compose.

The character set itself consists of three point sizes. The large type at the top of the *Index Medicus* is 14-point uppercase. The subject headings are printed in a 10-point font, upper case bold. The largest segment of the character set is six-point with both upper and lower case characters, regular and bold face. Several special characters are available in the six-point font, including a small set of diacritical marks that are required for certain foreign languages that are printed in the *Index*.

DESCRIPTION OF GRACE EQUIPMENT

The basic input mechanism is a magnetic tape transport—a standard Honeywell drive. The characters are arrayed in 48-bit words in the computer which are then copied out eight bits per frame onto tape. The tape is $\frac{3}{4}$ inches wide; the density is 400 frames to the inch. Each print line represents one magnetic tape record. (GRACE appears in Figure 1.)

The electronic control unit of the photocomposer consists of three main elements. There is an input converter which will accept the signals delivered from the Honeywell tape transport and convert these into the internal code required for the photocomposer. There is a buffer core storage area in the electronic unit which is used for storing the bits delivered for one print line. Finally, there is a series of solid state electronics which compute the flashing signals to drive the optical unit where the photographic process itself takes place.



Figure 1. An operator stands at the controls of the Graphic Arts Composing Equipment (GRACE) recently installed by the National Library of Medicine. (Photo by National Library of Medicine.)

The optical unit is the third major component of the system. Each one of the 226 printing characters in the machine is etched onto a glass matrix. The characters on the matrix are four times larger than they appear on film. Behind each of the characters on the matrix is an individual flash lamp with a condenser discharging system for firing it. The electronic unit controls the timing signals to fire the various flash lamps in the photo unit. The lamp includes a high-speed bulb with a six-microsecond flash time. At the end of each flash tube is a lens which aims the beam of light in the appropriate direction onto film.

The film-handling assembly, controlled by a stepping motor, advances the film from magazines one line at a time. Between the plane of the film and the matrix of characters is the reciprocating lens assembly. Here a lens sweeps back and forth making one sweep for each line to be printed. This means, of course, that one cannot really predict in advance what the flashing sequence of the characters will be. This will be dependent upon the relative geometry for each character—where it appears on the matrix and where it is to appear on film.

Between the lens and the film is a set of mirrors to compensate for two-dimensional dispersion of characters on the matrix and to align these accurately on the film.

Our system utilizes manual leading by a switch which controls the advance of the step motor that drives the film. Leading can be varied from one to eighteen points by an appropriate setting on this switch. Most of our publications are printed with six on seven leading.

In addition there are controls which provide tape searching features. If recomposition is necessary for a single page or a series of pages, the starting page number is dialed in and the tape is searched. Another button allows composition of a single page if this is required. When we have flash errors, signalling, for example, a dropped letter, we simply go back and recompose the complete page using these tape search procedures.

PROGRAMMING, SOFTWARE, AND OPERATING PROCEDURES

Input to the MEDLARS system is produced by means of Flexowriters, giving us an eight-channel paper tape. The only elements of typographic markup (and this is an important point in understanding our system) included in the input record are upper and lower case indicators which are supplied automatically by the shift key on the Flexowriter. This means that the computer programs control all of the formatting, selection of fonts, selection of regular or bold face, etc. A given data element always appears in a fixed font. Thus, we do not have general-purpose typographic

programs. We have designed the system to meet the specific requirements of our bibliographic publications, and we cannot take any other type of material and process it with these programs.

The Flexowriter hard copy is proofread by a staff of trained clerks who verify it against the original source documents—medical journals with data sheets attached.

At the end of each day, after correction and splicing, the paper tapes are read into a series of programs which we call the Input Module. This module does an extensive editing of the paper tape record. In order to even out the work load, each individual citation that appears in one of our bibliographies is formatted for the GRACE equipment by the input programs. This involves conversion of each character to be printed to the appropriate eight-bit code, and formatting of the citation for *Index Medicus*.

The formatting programs include a partial margin justification which is accomplished by varying the inner word spacing on the line. We attempt no hyphenation in these programs, because we don't believe this necessary for a directory type of publication.

Each completed record is written out on a magnetic tape file which we call the Processed Citation File (PCF). Another file is created for use in the retrieval system—the Compressed Citation File (CCF).

When we are ready to run a given publication, we will enter a parameter card into the computer which says, "Today I want to run the following publication." This card will trigger a series of programs which we call the Output Module. The appropriate citations from the Processed Citation File are selected for final processing. In the case of the *Index Medicus*, every citation entered since the previous month's issue will be selected for printing. In recurring bibliographies the selection is based upon the subject content of the article.

The same basic programs are used for all bibliographic publications. After the citations have been selected from the Processed Citation File, we enter a series of sorting programs which expand the citation under the various subject headings or descriptors to which it applies. An average article in *Index Medicus* will be cited five times, under three different subjects and two author names.

Page composition programs are run next. A complete page of type is constructed in core memory of the computer. Citations are assembled into a three-column format. Page headings, running heads, page numbers are determined and inserted in the proper locations. Once a page has been completely formatted, it is recorded one line at a time onto magnetic tape, with a record gap between each line. However, a line will cut

across three columns of the printed page because the column determination work has been done in the core of the computer. So when we say a "line," we really mean a line cutting across three columns of type.

The detailed magnetic tape specifications can only be summarized. A tape label record is required followed by one tape record for each print line. Each of these print lines has a banner word associated with it which gives the report number, page number, and line number of that particular line of type. At the end of each page the last line includes an end-of-page indicator, which occupies a control code of the eight-bit set. At the end of each report (there may be several reports on the same tape), there will be an end-of-report indicator, utilizing a different eight-bit control code. At the end of file, there is an end-of-file indicator, and finally, there is a physical end-of-reel indicator if the file carries on to more than a single reel of tape. All of these end indicators are recognized by special features of GRACE.

After the tapes have been run through the photocomposer, the exposed film is processed by a Kodak Versamat processor installed at the Library. The processing speed is considerably faster than the basic speed of the GRACE equipment, so there is no backlog at this point.

After the film is processed, it goes to a quality control station where it is inspected on a light table, cut into page-sized sheets, and packaged for delivery to the printer. We do no printing at the Library. The printing of the *Index Medicus* is handled under contract, awarded by the Government Printing Office.

OPERATIONAL EXPERIENCE

Starting with August 1964, we have completed 10 issues of the *Index Medicus* using the GRACE system. (See sample page in Figure 2.) The *Cumulated Index Medicus* for 1964 was also produced on the equipment, in two weeks' time. It consisted of 6,000 pages, with about 150,000 articles referenced.

To date 25,025 pages of production have been run. The total number of hours of production usage is 554. The over-all total usage of the machine has been well over 1,000 hours, much of this for testing of new bibliographies. We are using the equipment less than a full shift a day, except for the peak load situation for *Index Medicus* when we sometimes run 12 hours straight.

The percent of uptime to date (total hours of production over total hours of production plus downtime) has been 94.7, which is considerably better than our fondest expectations.

OCCUPATIONAL DISEASES

S-2375

Figure 2. Sample page from *Index Medicus*.

There are some limitations to the equipment. For example:

1. The character set is limited. A large general printing establishment would require more characters than are available in this system. However, in the specialized work we are doing we can get along comfortably with 226 characters.
2. Speed is also a limiting factor. By computer standards 300 characters per second is rather slow.
3. The accuracy of the character placement is imperfect. If you examine our copy microscopically, you will see that it doesn't yet approach letterpress quality. However, it is considerably better than any other type of direct computer output that operates at comparable speeds.

4. Programming complexity is substantial, and a major investment in writing of programs is required.

These limitations are minor ones, however, and we have been very well satisfied with the GRACE equipment and its performance as part of the MEDLARS system.

THE AUTHOR

Charles J. Austin was graduated from Xavier University, Cincinnati, Ohio, *summa cum laude* in 1956 with a degree in Mathematics and Physics. He began his career in data processing in 1957 with the Proctor & Gamble Company, Cincinnati, where he worked for three years as a computer programmer and systems analyst. In 1960 he accepted a position as Data Processing Supervisor at the Robert A. Taft Sanitary Engineering Center of the U.S. Public Health Service, also in Cincinnati. In 1962, Mr. Austin transferred to the National Library of Medicine in Bethesda, Md., where he heads the Data Processing Division. In this capacity he is currently supervising the information retrieval system and coordinates the Library's research and development activities.

PART III

TECHNOLOGY

Chapter 8

TRENDS IN PRINTING TECHNOLOGY

ROBERT E. ROSSELL

Managing Director

*Research and Engineering Council of the
Graphic Arts Industry, Inc.*

AS I LOOK at the printing processes as they exist today, I do not see a process that might be called electronic printing, since that term would indicate a technique employing vacuum tubes and gases. It is true that in printing today we use these devices in a limited way to control our conventional and well-known printing to produce more and better printing in less time.

The Graphic Arts, or printing industry, is a craft-oriented industry of small businesses. I do not mean to imply that the industry is small. It consists of many small business establishments, the total producing a large industry.

If one is to give credit to any person or persons for bringing about the emerging technology within the Graphic Arts industry, it would be unkind to thank only the electronic-oriented scientists. The chemists, physicists, and mechanical, electrical, and chemical engineers should receive an equal share of thanks and acknowledgment.

HISTORICAL REVIEW

In looking back upon the period of 1935 to 1945, we find that the industry was working relatively slowly in producing a quality printed product.

The growth of lithography was stimulated during the early part of this period by the depression, because lithography was the avenue to a printed product at a price people could afford to pay. Although there was some very high-quality production, basically the rapid growth contributed to the production of some poor-quality work. It was also during this period that lithography truly came out of the stone age. It became a rotary process using a relatively thin zinc plate which contributed to an increase in printing speed, resulting in the lower cost.

The Lithographic Technical Foundation, established in 1924 as a technical cooperative group within the industry to develop the process, contributed much toward this growth. Heretofore, each man in the shop carried his formulas in his hip pocket. An apprentice, after serving an appropriate length of time, became a friend of the journeyman with the result he was granted the privilege of copying the material in the little black book. The Lithographic Technical Foundation developed and disseminated sound technical information which some people used and some did not. By and large, those businesses that did use this readily available knowledge have grown with the industry.

During this period of increasing lithographic production the letterpress printer continued to use flatbed presses capable of producing 2,500 impressions an hour under most favorable conditions. Compared to rotary production—whether lithography, relief, or gravure—this was very slow.

The development of the so-called “offset sprays” helped the letterpress printer achieve this speed of 2,500 to 3,000 impressions.

WORLD WAR II AND LATER

During World War II the industry was handicapped by the lack of experienced lithographic craftsmen, many of whom were called into the military service to produce the millions of maps that were printed by the lithographic process.

In the late middle 1940's the Lithographic Technical Foundation expanded, and new platemaking techniques were developed. Similarly, new techniques were developed for the letterpress process. Developments in Europe, primarily in Germany, led to the presensitized lithographic plate, which has been a great boost to the lithographic process. The need for skilled platemakers to perform the critical coating operation in each shop was minimized, for the use of the presensitized plate eliminated

this operation. This function was performed by the plate manufacturer under controlled conditions, using mass-production coating equipment, materials, and techniques.

The later 1940's saw phototypesetting become a reality. The first phototypesetting equipment, the Fotosetter, produced by the Intertype Company, was installed in the Government Printing Office. This machine was not a radical departure from the well-proven circulating matrix line-casting machine, for essentially it substituted a high-speed camera for the hot-metal molding equipment. As usual, one development stimulated others. So, in the 1950's there were numerous other developments in phototypesetting.

Also in the 1940's and early 1950's the Dow Chemical Company moved into the Graphic Arts industry with the development of the Dow-Etch, fast-etch, or one-bite-etch for etching magnesium relief printing plates. The ability and know-how of the craftsman determined the quality of photoengravings requiring powdering—some were good, some were bad. But the availability of the Dow-Etch delivered a plate in much less time than the conventional methods and required less skill on the part of the operator.

Here again we see a case where one industry announces a product and then another industry that can be competitive begins or accelerates a move forward. Magnesium was not available theretofore as a letterpress printing plate. Magnesium therefore took business away from zinc. Zinc came up with a similar etching technique, so today we have a fast-etch process available for either zinc or magnesium.

During the 1940's also there was a great increase in the availability and use of heat-set inks, which meant that all printing processes could be greatly speeded up because no longer was drying the major factor in limiting the speed of printing. There were other problems, but this development contributed much to speeding up the printing processes.

In the 1940's the American Newspaper Publishers Association Research Institute was formed. This was an effort to keep abreast of technical developments emerging from many sources, to report to the association's members the potential of these developments, and to assist members in introducing new materials, equipment, and techniques into their plants.

The Springdale Laboratories of Time Incorporated were also set up at this time to keep abreast of technical developments and conduct research and development to direct promising items into their own application. Although Time Incorporated does not operate its own printing equipment, it provides a means to insure that its contract printers are up to date in modern technology.

The later 1940's saw also the establishment of the Research and Engineering Council of the Graphic Arts, and the Technical Association of the Graphic Arts (TAGA). These two efforts reflected increasing interest in the technical aspects of the industry. Both groups were organized primarily for the dissemination and exchange of information. Neither was to operate a laboratory.

The Research and Engineering Council is management-oriented. TAGA is oriented towards technicians, scientists, and engineers. Management needs to know that a new process, material, or equipment is on the horizon or available, and what potential it offers with respect to quality and production. The scientists' interest is, deep down, more in the nuts and bolts necessary to produce the item.

In the 1950's a host of items came to the forefront, most of them further developments of "takeoffs" from research done for the benefit of other industries.

Laminated duplicate plates and tension lockup have greatly helped the high-speed letterpress printer to print more and bigger magazines. It is doubtful that *Look*, *Time*, *Business Week*, and *Newsweek* could be produced in the quantities they are without the availability of these items. We would be remiss if credit were not also given to the manufacturers of presses, rollers, and paper.

Other phototypesetting machines such as the Photon and the Linofilm were introduced. These, like the Fotosetter, are keyboard operated. However, both of these machines are a radical departure from conventional machines—they were designed and engineered as phototypesetting devices from the ground up.

Perforated paper tape was introduced to operate these machines to achieve higher productivity. Printing by web, whether offset, letterpress, or gravure, enjoyed a great growth during this period.

In 1959 there was announced the development of wrap-around relief printing using zinc, magnesium, and "Dycril" photopolymer printing plates. Dycril plates, a development of E. I. du Pont de Nemours & Company, also were made available for conventional relief printing. Today we find that wrap-around printing is practiced at considerably higher speeds in both sheet-fed and web-fed methods.

The 1950's also saw the use of electronic scanning machines for the separation of color. Here is an example of electronics moving into the Graphic Arts industry, not as a basic printing process but as a very useful tool in the preparation of color process printing.

Not all of the developments mentioned are being used to the extent that many people predicted they would be, or some people believe they

should be, because there appears to be a reluctance in the Graphic Arts industry, as in other industries, on the part of the craft to accept them.

In addition to the color separation, electronic scanning was introduced whereby copy could be scanned and electronically engraved in metal or plastic to form a relief printing plate by a burning or a cutting process. The primary acceptance of such equipment has been by the small newspapers, which did not have easy access to photoengraving services or did not have enough work to justify the installation of such facilities.

RECENT TECHNICAL DEVELOPMENTS

There is considerable argument as to when the Graphic Arts industry began to accept and use perforated tape for the operation of linecasting machines. It is reasonably safe to say that such equipment was available in the late 1930's, and it was used to a limited extent in some newspapers and in a few commercial houses during the 1940's and early 1950's. The commercial houses became seriously interested in the late 1950's. In 1958 the Research and Engineering Council held the first of a continuing series of meetings on tape operation. The primary objective of this first meeting on tape operation was to point out—to the people operating typesetting machines and to the people who were supplying tape equipment or who were potential suppliers—that this was one of the avenues to increasing the productivity of the typesetting. A number of printers had indicated that the typesetting operation of their business was a money-loser, and that it was necessary to do something to bring it into the profit side.

At the 1959 Graphic Arts Exposition in New York City, linecasting equipment developed primarily for tape operation was first exhibited. This equipment demonstrated an increase in productivity over conventional machines modified for tape operation. These newer machines have been well received by the newspaper industry, although not quite so well in the commercial plants. The commercial printers seem to wait for something a little better. The newspapers have an immediate need for higher-speed typesetting. People buy a newspaper because it is timely, so there is need to get it out in a hurry.

In the early 1960's we see electronics in some form or other beginning to come in, primarily in the form of control devices; for example, the magnetic tape recorder was introduced to the proofroom. We now find many tape recorders being used to great advantage in proofreading.

This was also the period of introduction of computerized typesetting. It is generally agreed that the first computerized equipment for typesetting was the directory tape processor (DTP). The first commercial installation

was in May 1961. The DTP was designed primarily for the production of telephone books, which require a lot of typesetting and are very time-consuming. Today, over 75 percent of the telephone books are being set through the directory tape processor.

In May of 1961, CBS Laboratories presented a paper on the Vidiac. Very few people realized the impact that such a device or similar devices could have on the industry, but today we know that it is the basis for the Linotron.

In July of 1961, the Massachusetts Institute of Technology issued a news release announcing the work of Professor Barnett in using a computer to produce typesetting. He used one of the larger IBM computers, with a Flexowriter for the input. The type was produced on a Photon. These items were used because they were the only such equipment available to Professor Barnett.

Other recent technical developments include a relief printing plate by the Eastman Kodak Company. More recently, Metals & Controls, a division of Texas Instruments, has announced the development of its so-called TI Plate. This is a unique metal-clad plate of aluminum and zinc. Such a plate is etched by the Dow-Etch process. The thickness of zinc is the depth of relief. When the etch reaches the aluminum, etching stops.

These and other developments of wrap-around plates enable the high-speed magazine letterpress printing presses to achieve even greater speeds than with conventional electrotpe plates or even with the laminated electrotpe plates.

As we gain more speed, we need controls, because no longer can a man take time to react and walk to a specific control point on the press. The press has to correct or adjust in a hurry. Many people today are engaged in the development of register controls, color controls, web break detectors, and other devices to automatically control the press at these high speeds. In other words, many printed pieces may be completed before an adjustment can be made by a human being. So electronics can be very helpful to the industry.

Electrostatics is another significant technology, used primarily in duplicating.

RESEARCH IN THE GRAPHIC ARTS

The Graphic Arts industry has not been in a position to sponsor research, nor has it had government support in any large measure. The industry takes something and gradually develops and works it into its own shop. For this reason, progress is slow.

The progressive printer, typesetter, and binder must stand back and take a good, hard look at the industry. He must look at it in the broad perspective rather than as in the past. If he does this, he will see that the future of most printing production is bound up in the rotary principle in some form, whether it be relief, planographic, intaglio, or printed in sheet or web. At one time in the past, I might have predicted that one process was going to take the lead, and that we might eventually have only one or two basic processes. But today I see nothing on the horizon that indicates this could be true. There is room for all three processes, and they will certainly go forward together.

I would like to make a special plea that the industry needs the help of every technology. We can no longer think in terms of units, we have to deal with a system.

If we go back and look along the production line, we see that hot-metal type is outliving its usefulness. It is only providing reproduction proofs for platemaking, and it is unwieldy and cumbersome at best.

LOOKING AHEAD

The role of the computer in typesetting is indistinct in the sense that the installations using computers today in typesetting are not really satisfied with it as it stands. But these users are not discouraged to the point that they want to give it up. They want to move on. We have to recognize, too, that computerized typesetting may be utilized best in a service center, and certainly not in the two or three-man shop.

Computer phototypesetting is the area for the future, because of the higher speeds that will be available in phototypesetting devices. However, I should point out that the industry is not holding back and waiting for extremely high-speed systems in computerized typesetting; some people have found that the smaller systems, such as a special-purpose computer, will do an excellent job.

The industry needs to take a good look at the input product for the computer—the type of input produced at a keyboard as a perforated paper tape which disregards hyphenations and line lengths as they are to be performed later by a computer. It is not simply a question of how much faster a person can operate a perforator compared to a keyboard on the typesetting machine, or the cost of machines with or without justification equipment, and so forth. It is an area that requires careful study and investigation.

Mr. Duncan, of the University of Newcastle in England, is concerned about the time delays and cost of scientific book production. In seeking ways to improve the situation, he is looking to computer technology. As

a result of his early investigations with respect to typesetting, he is asking many questions which the Graphic Arts industry is hard put to answer.

Mr. Duncan says the industry needs to forget some of its well-tried techniques and, in some cases, some of its aesthetic value in the production of printed matter to provide flexibility so that everybody—the computer technologist, the typesetter, the customer, the designer—can work together to use this new technology of computers to advantage.

Some say that the designer can't be changed, or the customer, but I feel that somewhere along the line when you really put the economic figures out on the table, people you think you can't change *do* change.

THE AUTHOR

Robert E. Rossell has been managing director of the Research and Engineering Council of the Graphic Arts Industry, Inc., since 1954. He has been active in the Graphic Arts industry for over 25 years, having had experience in camera and off-set platemaking, technical sales engineering in photomechanical equipment, and research and development. Before his present position he spent 13 years in map reproduction research and development activities with the U.S. Army Corps of Engineers. In 1962 Mr. Rossell received an Elmer G. Voigt Award for outstanding service in the field of Graphic Arts education.

Chapter 9

EXPERIENCE IN DEVELOPMENT OF AN ELECTRONIC PHOTOCOMPOSER

VICTOR M. CORRADO
Mergenthaler Linotype Company

HISTORICAL BACKGROUND

My company's interest in electronic photocomposition goes back to 1946, three years before I was employed by them as a junior engineer. At that time, you may remember, an interest in offset printing was everywhere evident, there being general agreement in the trade that its use would dramatically increase during the post-war years. Such an increase would inevitably make photocomposition more attractive; so the Mergenthaler management decided to start development of phototypesetting equipment to complement its well-established hot-metal line.

As a first attempt in this new field, it built a closed-circuit television system, and tried to produce satisfactory type on the face of a cathode-ray tube. Well, as you all know, the cathode-ray tubes of 1946 were fairly crude devices—satisfactory for the commercial television of the day, but completely inadequate to meet the rather severe requirements of the typesetting trade. The illumination levels were too low to expose standard photographic materials properly, and the resolution capability of the tubes was not high enough to produce type that was sharp enough for

the printed page; so, after a couple of years of work on the system, we put it aside until such time as the tube capabilities would be improved. As a matter of fact, my first assignment at Mergenthaler was to help in the evaluation of this early attempt at electronic phototypesetting.

Even before we set this electronic approach aside in 1949, we started to develop another phototypesetting machine. This machine was nothing more than an adaptation of the standard linotype, a camera replacing the ordinary casting mechanism. In the standard linotype, as you know, the brass mats that carry the molds of the letters are dropped as the copy is keyboarded, are assembled into lines, and then are moved, line by line, to the casting mechanism. There a line of type is cast. In the phototype-setting adaptation, the mats were coated with black paint and the characters were filled in with white lead, so that the assembled lines could be photographed instead of cast.

We built one of these machines and exhibited it. However, even as it was being built we realized that this approach was not the best one for us to take. We were trying to enter into a new technology with equipments and concepts that were almost 70 years old and, although our familiarity with these concepts meant that we could produce a functioning phototypesetter quicker, any machine produced in this manner would of necessity have limited capability. Its slow speed, for example, would not have been adequate to meet the newer demands. This definitely was not the path to take to practical photocomposition.

Therefore, in the early fifties we abandoned the linotype approach and adopted an optical-mechanical approach. Some of you may recall the first demonstration of our Linofilm—a semi-automatic, tape-operated phototypesetter that we exhibited back in 1954. Public response to this showing indicated that the machine must do more than the first model did to be a commercial success; so development along this optical-mechanical direction continued until in 1959 we came out with the first production Linofilm, a machine much more automatic and more versatile than the pilot model of 1954 had been.

Now there is no need to tell you that there were, during the fifties, technological advances in other fields as well. One of the fields that advanced the most was that of computer technology. During the first part of the decade everybody was so astonished at the ability of computers to do so much routine work so rapidly that they did not worry much about the appearance of the output. However, people became more sophisticated during the latter part of the fifties when their systems were producing huge amounts of output on line-printer forms. They wanted to publish much of this output, and they began to wonder if

there were some means of automatically typesetting the output of a computer to yield an attractive printed page. These desires became more intense in the early sixties, and a number of requests for proposals were given out by government and commercial agencies. To name a few, one of these agencies was the Department of Commerce, another the Department of Health, Education, and Welfare, and another was Western Electric.

Mergenthaler submitted bids on some of these items, but in retrospect I am quite happy that we were not awarded contracts to build some of the equipment that we proposed. I say this because with most of it, we were merely intending to expand on the basic optical-mechanical approach of our standard Linofilm. In retrospect we can see that if we had won one of these contracts, our work would have led us up a blind alley. The machines we would have produced would have met the needs of the early sixties as they had been set forth in the requests for proposals, of course; but they would have led nowhere as far as satisfying the constantly increasing consumer requirements was concerned. We might have produced an adequate machine for the early sixties, but it would have been one whose basic principles were completely inadequate for the late sixties.

In addition to these requests for proposals, there was another activity that played a significant role in providing impetus for the development of high-speed phototypesetting machines. That was the language translation program that was under way at the T. J. Watson Research Center of I.B.M. A system had been developed whereby Russian could be automatically translated into English. The actual translation part of the system was working fairly well; but the input and output stages were really posing problems. The output device being used was a line printer, and unfortunately a first-generation translation of Russian is difficult enough to read without having it in line-printer form. About that time we showed up on the scene and were able to install a Linofilm system at the output end of the translator. A Linofilm, of course, is by no means a high-speed typesetter in the sense that we use the word today. However, the application did prove emphatically that it was much easier to read the translation if it were printed in quality type.

Largely because of this fact, an additional study was proposed in 1961 by the Rome Air Development Center. This broadened the field to include more than merely providing an output device for the language translation program. A system, called the Lexical-Graphical Composer-Printer System, was requested that would automatically make up the

pages as well as set quality type, and would provide illustrative material automatically as well.

Mergenthaler was awarded this study by the Air Force after competitive bidding. We were directed to prepare a design specification for this Lexical-Graphical Composer-Printer after carefully investigating the equipment that was then available, the hope being that the requirements could be met by a combination of existing equipments. Well, first we investigated what we had and what some of the other manufacturers of Graphic Arts equipment had, and then we immediately looked into other areas. During the course of our investigation of these other areas, we looked into what CBS had in the way of video equipment; and, thinking back to 1946 when we had tried to set satisfactory type with our own closed-circuit television system, we were pleased to see that they had developed video equipment that could satisfy the illumination and resolution requirements of quality typography. We realized that this was the proper direction for Graphic Arts development, and decided to proceed with the development of video typesetting, irrespective of any immediate commercial demand for the Lexical-Graphical Composer-Printer.

We entered into an agreement with CBS in the middle of 1962 to build a phototypesetting machine. At that particular time we did not have the Linotron tube that I am going to describe in some detail later; however, all the fundamental elements that would be needed to make a satisfactory piece of equipment had been developed. And by 1964, when we received a contract from the Government Printing Office to build two sets of machines for them, we were already well along with the development, and were certain that the fundamental elements could be put together to make a satisfactory character generator and a satisfactory system.

THE LINOTRON

I should like to describe what the Linotron is and give the basic specification for the machine. The output will be on conventional lithographic film or paper. The output must be area composed. The machine will compose over an 8 by 10½ inch area. The machine must also, for galley-setting purposes, be able to set a continuous form 10½ inches wide. The input, of course, will have to be magnetic tape because we are talking about a high-speed machine. Output quality will be between the qualities of Linotype and Linofilm output. In defining the quality this way, I am comparing the output of the Linotron on photographic paper with Linofilm paper output and with a reproduction proof output made from Linotype slugs.

The type font is a 3 inch by 3 inch character grid. As a matter of fact, it is mounted in the same frame that we use for the Linofilm grids—the difference being the Linotron grid contains 256 characters whereas the Linofilm grid contains only 88. This storage method is a very important feature of Linotron. There have been several approaches to electronic characters generation that store type fonts on magnetic tape or cores or by some other electronic means. You people as typographers know that you will need several rooms full of equipment to store all of your type faces this way; so I do not think that much has to be said to convince you that 3 inch by 3 inch grids carrying 256 characters apiece are preferable as type sources. Each grid can produce types ranging from five to 18 points in size. The speed of the machine will range from 1,100 characters per second at five-point to 250 characters per second at 18-point.

Now let us consider the basic system. Imagine an incandescent lamp with a grid structure in front of it, representing the character grid. In line with it is a bottle-shaped object, which is the character generator tube. A cathode-ray tube displays each character individually in its proper position on the output page. Near the magnetic tape unit is the control section that synchronizes the entire system. Another cathode-ray tube, essentially the same as the first one, forms part of a servoing system that insures squareness at the corners of the page as well as in the middle. It also serves as a counting device. I will present a little more detail later.

As I said, each character grid contains 256 characters. Each character sits within a 12-point em square, and from each we can produce all the point sizes. Magnification and minification are done electronically by the circuitry of the machine. Below each character is a series of dots that represents the relative width of each character. Photographic material is the same as that used with Linofilm today.

Consider now the character generator. A light source equipped with condensing optics illuminates the entire back surface of the character grid. The characters are imaged onto the photo cathode on the back surface of the character generator tube, so that we have a visual image on the back surface. The photo cathode converts the light energy into electron energy; so that we have an electron image of the 256 characters on the right-hand side of the photocathode. The focus coils focus all the characters onto the back of an aperture plate. This aperture plate contains 256 square holes, the purpose of each one of which is to convert each character into a television signal. In front of the aperture plate is an array of selection grids, 16 horizontal and 16 vertical. By applying the

proper voltage to one vertical and one horizontal grid, we allow the electrons to pass through that and only that particular aperture. These electrons are collected by the output anode.

Consider for example the character "A." Perhaps you can visualize the electron bombardment of the back surface of the screen, and the conversion of the "A" into a video signal by deflecting it back and forth across the hole in the aperture plate and moving it down an increment at a time as the bombardment proceeds. The dots underneath the characters give the character widths. As they pass by the aperture, the control circuitry picks up the width information and tells the system where to position the next character to give it proper regard for the width of the character that precedes it. In this way we have true variable-width character assignments.

Consider now a 256-aperture tube, which has a photo-cathode side, followed by a deflection-coil system. At the far end is an electron multiplier or an amplifier. Nothing in the tube moves except the electrons. We don't move the grid, we don't move shutters; the only motion is electron motion. The tube is seven inches in diameter and about 18 inches long. It has proved successful beyond our expectations and will certainly provide a resolution capability far in excess of the requirement of the entire system.

For further understanding of system operation, let us consider the display and servo system. We display the characters on the cathode-ray tube and image them in their proper place on the photographic film. Another axis has a cathode-ray tube and a lens, and also contains a grating in place of the film. This grating makes it possible to square off the position of each character and also provides a means for counting the width of each character and positioning each character properly.

The current going through the deflection coil of the servo cathode-ray tube is the same kind as that going through the deflection coil of the character-display cathode-ray tube. The action of the system is to cause the beam in the display tube to follow the movement of the beam in the servo-system tube, which means that once we have selected the right grating position we know that the beam is in the right position to start setting a character. Another grating in the system, which consists of horizontal lines, permits us to position properly in the vertical direction.

As an example, let us say that we want to start a paragraph 100 units over and 50 units down. The first thing we want to do is to position the beam. We place 100 in a register. Then we turn on the servo cathode-ray tube beam and start passing current through its deflection coil. This deflects the beam in a horizontal plane. The beam is imaged onto the

grating, whose opaque and transparent lines cause the light to emerge from it in pulses. These pulses are counted. After 100 pulses have been counted, we know that the beam has moved over the desired 100 units. At the same time and in the same manner, we count 50 units down in the vertical direction. By the action of the servo system, the beam in the display tube has followed the motion of the beam in the servo tube; therefore we know that it is now in the proper position to scan the character onto the film.

Some features over and beyond those of the basic machine are being provided. We are providing an optical overlay capability, so that, if you have ruled forms or textual matter that is repeated page after page, you can make a slide and project it onto the output material before you set the regular copy. We are also providing a capability for horizontal and vertical line-rule generation. In an automatic error-check routine, the machine cycles itself at the end of each page and checks its deflection, its illumination, and several other items. We are also providing a 10,000 character per second output rate for small point sizes, and, perhaps more significantly, a 5,000 character per second rate for all point sizes. (Character quality at these high rates will be that of the standard-speed output, but character alignment will not be as good.) This will be useful for proofing purposes.

We can also provide a four-grid mechanical font changer, which obviously gives you a basic character availability of four times 256, or 1,024 characters. (Remember that each of these 1,024 characters can be produced at any of the point sizes that the system is capable of producing.) And then we are providing a turn-page capability which permits us to set this in a $10\frac{1}{2}$ by 8 array, a capability that will often be appreciated when tabular matter is being composed.

It should be pointed out that mechanical grid changing is relatively slow—a fact that might be very objectionable were it not for the area-composition capability that I mentioned earlier. Because of this area-composition capability, we can set all the characters on a page from one grid before we set any characters from another grid. We merely have to leave spaces for the characters that will come from succeeding grids. Only after we have completely finished (as far as the page being set is concerned) with the first grid is the second grid shifted into position. The number of grid changes per page, therefore, is never more than four, instead of being the much higher number that it would be if we had to place the characters on the page in the order that they appear on the copy.

For example, in composing a dictionary we might have as many as five or six grid changes per line if we had to compose in the conventional

fashion. If there are 100 lines on a dictionary page, we might have as many as 600 grid changes per page without area composition. But, because the Linotron will have the ability to compose by area, we can set all of the material from one grid, then shift grids, fill in the holes with the material from the next grid, and so on for a maximum of four grid changes. Said another way, the number of grid changes is equal to the number of grids being used, and is independent of the number of type changes within a line.

Area composition is particularly advantageous in directory work. To demonstrate this, I have split up a Manhattan telephone directory to show how setting this material in logical form really unburdens the computer. By logical form, I mean setting in the logical sequence of the alphabetical or numerical listing, starting at the top of the left-hand column, working down to the bottom, moving to the top of the second column, and so on. This mode of operation, which is perfectly feasible for an area composer, is much simpler from a programming point of view than working in a strict line-by-line mode, in which you would have to sort the items in the computer, pick out the first line in the first column, then pick out the first line in the second column, follow this by the first line in the third column, and so on. Of course, the computer can do this, but the procedure obviously adds complexity and expense to the process.

One of the ways of pointing out the capabilities of the Linotron is by listing the needs of different potential users and showing how Linotron meets them. Consider first the principal problem of existing computer listings—the poor legibility of the output. Because of this poor legibility, information density of necessity is very low. Very often it is possible to place three times as much information on a page with good typography without loss of legibility as is possible with a line printer—an obvious saving in paper and ink. Next, consider the book-printing industry. Those of you who are book printers know how desirable it would be to produce rapidly proof copies that use the same type styles that appear in the final copy. Galley proofs as produced today are expensive and slow. With the 5,000 character per second speed that I mentioned could be obtained with Linotron, the production of proofs would be cheap and quick. Admittedly, the type alignment at this high speed would not be as good as produced at standard Linotron speeds—however, it would certainly be good enough for proofing.

Great interest has recently been shown in the computerization of display advertising. Here the principal limitation of existing typesetters is that none of them are true area-composition devices. After all, most of them were not designed to handle the output of electronic computers, so why

would they be expected to include features that are only needed when a general-purpose computer is part of the over-all system? With a machine like Linotron that has area-composition capabilities, a whole new era in the computerized composition of display advertising can be predicted.

For the composition of news text, the high speed of Linotron makes it very well suited. A complete newspaper page can be set in about 70 seconds. Admittedly there are factors external to typesetting that must be considered here; however the potential capability is nonetheless apparent. Finally, it is worth mentioning that the Linotron will be a very attractive means of directory composition, because, among other reasons, it permits more efficient storage of information than is possible with metal slugs or photographic cards. And again, the fact that Linotron is a true area composer makes page revisions and other updating much simpler.

We call the Linotron a slave machine, by which we mean that it itself must receive its input information and instructions from an external source. This is another way of saying that you need more than a bare Linotron to have a functioning system—you need the system components that will control it. These components must provide what we call a formatted tape, which will furnish the Linotron with information about point size, character selection, character location, size of illustrations, location of illustrations, and the like. This tape is produced by a general-purpose computer that has been programmed with what we call our Master Typography Program.

In the Master Typography Program, information will be received from any one of three fundamental sources. One of these will be a keyboard that will produce paper tape, which can be converted into magnetic tape. This magnetic tape would then have on it the formatting instructions, which we call edit codes. For example, an operator at the keyboard would depress a key that says "head." He would follow this by the text of that particular head. When the keyboard input arrives at the Master Typography Program, the receipt of the "head" code will instruct the parameter section to provide line length, type size, type style, leading, and the like, all of which will be applied to the keyboarded text of the head that follows.

In addition to the tapes that are specifically prepared for processing by Linotron, there are tapes that will have been prepared without any concern for their eventual processing by Linotron, but that will have to be so processed nevertheless. We call these "existing tapes." By means of a relatively simple edit-insertion program, the edit information can be inserted so that the modified tape can in turn go through the Master

Typography Program to set completely composed, typographically attractive pages. Anything that would be keyboarded in the future and therefore could have the edit codes incorporated in it during its original preparation can be handled.

Let us consider a broader concept of the Linotron system. Such a system has the capability of inserting graphical items. In other words, the system will store not only the text, but half-tone and line illustrations as well; and both text and illustrations will be placed on the film output by the system. One tape unit is the input for the text-control information, while another tape unit, a video-tape unit, provides the input for the graphics. The graphic copy, conventional continuous tones or half-tones or line art, enters via the video-graphic copier.

The operator will sit down at the video-graphic copier, take one of these photographs, line it up on the grid, and, when it is in its proper position and a serial number has been inserted, the device will scan out the picture and record it on video tape. Thus we have stored on video tape the pictures that will be produced in the final output stage.

The Format Processor, a special-purpose device, has the formatting logic built right into it. When there are jobs that must be done day in and day out, it is often more economical to build a special-purpose device to do page composition than it is to tie up a powerful general-purpose computer with such a task. There are two tape units, one for input tape and the other for output tape. The input tape supplies the control information for the graphical items as well as the text information.

By way of summary, I should like to say that there are two points that I consider very important. One is that Mergenthaler believes that the future of typesetting and composition lies in the video technology area, because this is a field whose expansion continues to encourage the development of new equipment. The other is that we believe that area composition is here to stay.

THE AUTHOR

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Chapter 10

COMPATIBILITY OF INPUT AND OUTPUT DEVICES

P. L. ANDERSSON

Andersson Associates

COMPATIBILITY is the ability of machines to talk to each other. The most perfect example of compatibility is that of a computer and its magnetic tape decks. These machines were built to communicate rapidly and effectively. Here, there is no problem. Going further afield, we find machines intended for the same purpose, and using the same type of input, which cannot communicate with each other at all. The classic example of this is the Remington Rand and IBM punched cards. The machines of both companies use punched cards that are exactly the same size, shape and weight, but the hole spacing is at different intervals, and one uses round holes while the other uses rectangular ones. A superficial examination of the two cards shows that they cannot possibly be used on the same machines.

TYPES OF COMPATIBILITY PROBLEMS

There are three types of compatibility problems facing us in the Graphic Arts. One of these is basic, and is concerned with the special symbols and large character sets used. Another is inherited and stems from a lack of need or desire for standards in the design of past equipment. The third is largely a consequence of poor systems design.

Basic System Incompatibility

Most computers simply cannot handle the special functions and the large numbers of characters used in the Graphic Arts. Older computers are capable of handling only six-level codes, giving a total of 64 possible characters. Present-day computers, of course, can usually handle eight-level codes, giving a possibility of 256 characters, which is sufficient for most plain text English with bold face headings, italics, and so on.

Any time one deviates from plain text, however, there is again the problem of an insufficient number of characters. In many machines, in fact in most machines, this problem has been solved through the use of shift characters, the so-called precedence codes of the teletype system, where one character is used to introduce a change in the interpretation of the following characters. While this expedient solves the immediate problem of getting more characters into a six-level code such as the TTS code, it reduces the total number of characters that could be available if one had instead simply added another bit to the existing code; it further reduces the speed of the machine which is reading the code by the time required to read the extra characters. It also reduces the keyboarding efficiency by the time required to introduce these characters. Thus we are, in effect, introducing a very narrow funnel into our system when we attempt to go through six-level codes, whether they are native to a computer or not.

A six-level computer can, of course, handle ordinary TTS tape acceptably, but we are still in bad shape if we are trying to obtain the number of required characters from a typewriter keyboard, which is more or less standard in computer technology. The 44 keys of an ordinary typewriter are simply not enough to punch the 64 characters possible in TTS code. This fact resulted in the solution proposed by IBM some time ago: a coding system using the \$, followed by an instruction. For example, \$QL would cause a quad left. The \$QL is, of course, three characters, as opposed to one on the TTS keyboard, and thus cuts the efficiency even further. The \$ is simply a special form of precedence code.

Both Teletype and Fairchild have keyboards which have keys for all 64 code combinations of the TTS tape. This is a big improvement. Here the frequent symbols, such as quad left, quad center, etc., do have separate keys. It is also possible to obtain a Monotype keyboard which has enough keys for all 256 combinations possible in eight-level codes. Each one of these keyboards, including the typewriters, is best suited for a given range of applications.

The last thing I want to do is leave the impression that for Graphic Arts use you want the keyboard with the most number of keys. For in-

stance, if you are in an area where trained operators are difficult to obtain, and if you are setting straight text matter and have no great number of typographical functions, your best buy would be a typewriter-style keyboard. If you have trained operators and are doing complex typography it may be best to use a Monotype-style keyboard. If your requirements fall somewhere in between, you may have to decide on going one way or the other. You must, however, always match the machine, the job, and the operator as well as possible. The often forgotten operator is as much a factor in the compatibility considerations as the machines themselves. There is no substitute for proper matching of the machine to the operator.

Hardware Design Incompatibility

Whatever the type of keyboard used, the most common tape utilized in the Graphic Arts industry is TTS tape, although you would not think so from the large number of machines which have been designed around some other tape. Five years ago, there were only a handful of people in the computer business who had ever heard of TTS tape, despite the fact that more TTS is produced than any other in the U.S. TTS tape is, therefore, relatively uncommon in the computer industry, and there was quite a flurry when computers were first introduced in the Graphic Arts, because of the need to get the proper types of punches and readers. Even though this problem has now largely been solved, in that both computer people and Graphic Arts people know the differences, there are always some people who are trying to run one against the other.

Looking at the physical dimensions of various paper tapes (see Figure 1), you can recognize the differences. There is more than the difference in advanced sprocket holes; there is also the difference in hole position with regard to the edges, which prevents you from using the standard tape on an advanced reader and vice versa. It is possible, however, to modify a TTS operating unit to read standard tape if the code is correct.

Not only is standard six-level TTS tape different from the five-, six-, seven-, and eight-level tape used in most computer-operated equipment, but the Graphic Arts industry also has some odd-ball tapes of its own. The 15-channel Linofilm and the 31-channel Monotype are common examples. Also, there are machines in Europe which use tape with square holes. Then there is a machine in the U.S. which uses magnetic tape. This is the Alphatype, and it is completely incompatible with any other type of magnetic tape transport that has ever been used.

I grant that the 15-level Linofilm and the 31-level Monotype tapes are far better able to handle the large number of characters required in the

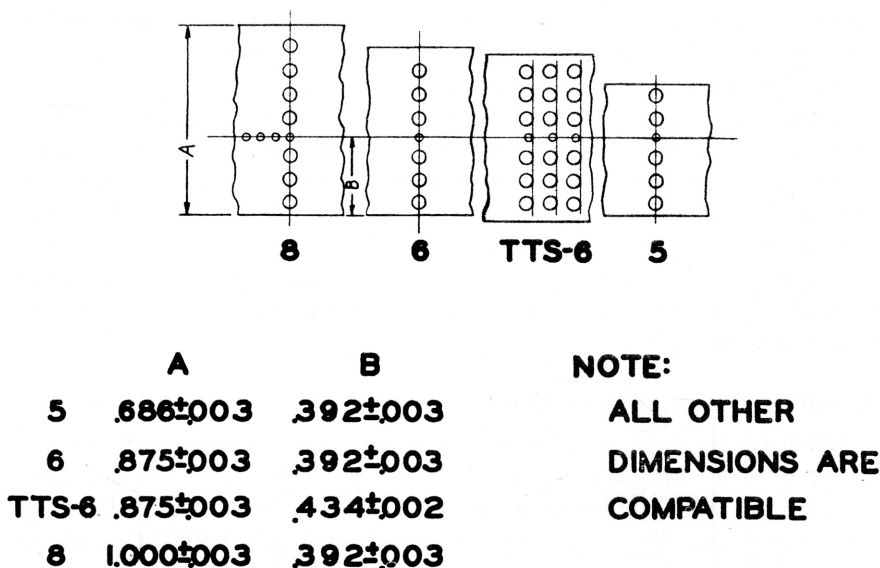


Figure 1. Comparison of paper tape dimensions.

Graphic Arts. Even so, in the interest of compatibility, the manufacturers are now starting to change from the large multi-level tape to a standard based on six or eight levels. Both Mergenthaler and Monotype have recently announced six-level operating units for their machines. This, then, is a problem which is slowly being solved. I know of no new typesetting machines or, for that matter, new keyboards which are being designed around anything other than standard six- or eight-level tapes.

I particularly want to call your attention to the Teletype Model 33 keyboard, punch, reader, and printer as an example of the trend toward compatibility in other applications. This machine is not intended for the continuous use for which most typesetting systems must be designed. It is, however, an excellent stand-by for Teletype service. My sole purpose in referring to it is to point out that this machine now has a standard four-row typewriter keyboard and is capable of punching and reading eight-level tape. Remember, this machine is intended for use in the communications industry, which has for many years used nothing other than five-level tape and three-row keyboards. So, even away from the Graphic Arts, other industries are moving increasingly toward the use of eight-level codes and other indications of compatible machines.

It is necessary to have compatible machines in all computer applications if we are to avoid continuously converting tape and if we are to

avoid the errors which will be made by inexperienced personnel when a tape generated on one machine cannot be read on another.

Incompatible Code Systems

There is a third factor which enters into the problem of compatibility in machines; this is the somewhat simpler problem of code systems. One of the best illustrations I know of incompatible code systems has been worked into the Friden Justewriter. Its code is the exact reverse of the TTS code. You can sometimes, on some types of readers, use Friden tape by turning the tape over and reading it backside up. In other words, the designers of the equipment were so anxious to be different that they selected a system which is totally reversed from that in common usage. In all fairness to Friden, their choice was made many, many years ago, before compatibility was as important as it is today.

These then are the three types of incompatibility which haunt us in the Graphic Arts. We have basic incompatibility of systems because of poorly matched character counts, symbols, and special functions. We have hardware design incompatibilities, where the types of tape used are different. And we have incompatibilities in codes and in other factors which are not basic or a function of hardware design, but were simply a poor or ill-informed choice at the time of the initial decision.

SOME POSSIBLE SOLUTIONS

Good systems design becomes more and more important as computers become more and more common in the Graphic Arts. The first commercial computer, the Univac I, was delivered only 14 years ago. Today there are more than 27,000 computers in use in the U.S. The beginning part of the production curve for computers is very nearly a straight line. It starts to upswing around 1960. A similar chart for computer installations in the Graphic Arts shows a similar straight line, but we are still on the straight line portion of the curve; so on the basis of what has been happening over the past year, and taking the general similarity of the markets into account, I firmly believe that we are now at the point where this curve is about to behave much as the one in general data processing. I therefore expect a sharp increase in computer usage in the Graphic Arts.

One of the factors limiting the use of computers in the Graphic Arts is that the paper tape generally employed as input and output simply cannot be read and punched fast enough to fully utilize the speeds possible with a computer. Now I know that all tape has to be keyboarded at

present, and that keyboarding isn't any faster whether you use magnetic tape or paper tape. It is, however, a question of tying up a machine for which you are paying several thousand dollars a month rental to read paper tape when it could be inputting the same information in magnetic tape at 50 times the speed. Machines have been built to keyboard directly onto magnetic tape, but there are none available now which are suitable for Graphic Arts input. In addition, a reel of magnetic tape can carry the same amount of information in one inch that paper tape can carry in 25 inches, and it is much thinner; thus a 2,500-foot reel equals about 75 similar reels of paper tape at the lowest common packing density of 200 bits per inch. Some of the later tape-handlers are capable of packing densities of the order of five times this, or 1000 bits per inch, in which case the reel could contain the same information that would require 375 similar reels of paper tape, a pile over 30 feet high. What's more, when there is no further need for the information, the magnetic tape can be erased and used over again.

Now I don't say that this means we should throw away all paper tape punches and readers and go immediately to magnetic tape. Reading and writing magnetic tape are much more expensive than the similar operations on paper tape. There are a number of applications, however, where the use of magnetic tape is more than justified.

On the output side, most computers are fast enough so that difficult data-processing problems can usually be handled easily, but the computer is limited by the speed of the output. Most typesetting computers, for instance, are punch-limited, so that even with a large number of calculations or a difficult format they can still maintain punch speeds. The maximum speed for punching paper tape is about 300 characters per second, as opposed to a possible reading speed of about 1,000 cps, so the output is the seriously limiting factor. The problem is compounded when using machines which require more than one frame per character. In order to utilize the Linofilm, for instance, one must punch three characters in the output tape, cutting the possible speed to about 100 cps, and the more usual speeds of about 100 cps to closer to 30 cps. Monotype is a little better in that only two characters in the tape are required to drive the machine, so the effective speed is around 150 cps for a 300 cps punch and 50 for the 100 cps punch.

In both these cases, however, the decrease in speed is a necessary consequence of the increased character set and the number of type fonts available, so the price we pay on the output end for handling a great variety of characters is a decrease in speed of the punch and, thus, an effective decrease in the speed of the entire system. This is giving rise to

a definite need and desire for typesetting machines which use something other than paper tape as input medium, and magnetic tape is, again, the best candidate.

Up to this point, it seems that we have been overly confined to keyboards as input machines. Of course, there are other possibilities, even though ultimately these may be concerned with some type of keyboard. One alternative is the possibility of using computer-prepared directories, lists, tables, and even in some cases text matter, such as abstracts, as input. For special applications these possibilities cannot be overlooked. The Government Printing Office, for instance, has a very high incidence of this type of work and is now prepared to accept copy in almost any form in which a government bureau can send it—magnetic tape, punched cards, and various types of paper tape.

There is also the intriguing possibility of using optical character recognition (OCR) systems as input devices. OCR systems can accept typed or printed copy and convert it to a machine-readable form at a speed which permits them to be directly on-line to a computer. The problem is cost. A machine which can accept typed pages prepared with a special typewriter will cost \$150,000 or more. On the other hand, a machine which can accept several of the common typewriter types, that is, a multi-font reader, costs about one-half million dollars. It is possible to build a machine which will read just about everything, but it is not yet economically feasible.

These OCR machines are attractive simply because they can read copy directly. It is easier to type than to punch tape, because of the interlocks on tape-punching keyboards, and it requires a great deal less skill. Many manuscripts have already been typed under controlled conditions before they have reached the composing room and would not have to be rekeyboarded. Also, OCR machines can read copy at high speed, of the order of 2,500 cps. So an OCR reader can become part of an extremely attractive Graphic Arts system. I look to OCR as the input system of the future, and my views are even shared by some printers. (Perry Publications, West Palm Beach, Fla., has ordered an OCR system.)

As an illustration of the improvement to be gained by typing, the following figures on speeds of keyboarding may be interesting:

Manual line casting	3,500 ems/hr.
Monotype keyboarding	5,000 ems/hr.
TTS (375 lines/hr.)	5,200 ems/hr.
Tape typewriter	9,000 ems/hr.
Typewriter (60 wpm)	11,900 ems/hr.

I do not say that these figures are absolute. I simply present them as a good relative guide to what one can expect experienced operators to accomplish on each of these machines. You can see that choice of input influences speed so we must add speed to the over-all problem of compatibility.

Now let's analyze briefly the types of output units available for computer composition. Taking hot-metal machines first, we have only three choices: the Linotype, the Intertype, and the Monotype.

Both the Intertype and Linotype are linecasting machines capable of utilizing the six-channel TTS tape directly, and setting tape at approximately 10 to 15 lines per minute. These machines are particularly prone to some types of errors, such as transpositions, with rates which may run as high as five percent.

The Monotype requires two frames in six-level tape to drive the standard 1515 or 1517 machines but has 225 and 255 characters available, respectively, as opposed to the 90 or so available from linecasters. The tape reader used on Monotype is unusual, incidentally, in that it can accept both TTS and standard tape interchangeably, even though the coding is special and must be computer-generated. While the speed of the Monotype is only 2½ to 3 cps, the caster alone is relatively inexpensive and it is somewhat more flexible typographically, as most of you know. This completes the entire range of hot-metal machines. I think there should be more of them, but there just aren't.

In photocomposing machines, we have a much greater selection. Here we have machines which are direct descendants of hot-metal machines, such as the Harris Intertype Fotosetter, which is now TTS tape driven, and the Monophoto, which is a direct descendant of the Monotype machine and can be operated by a seven- rather than a six-level operating unit. These machines are valuable in some cases, because they permit the use of tape which has been initially prepared for hot-metal machines to be easily converted for photocomposition. They have a further advantage in that they are familiar machines to machinists and operators; thus, they do not present quite the change that some of the other types of photocomposing machines do.

Photon was the first to introduce a spinning-disk type of photocomposer which was not a converted hot-metal machine. In their unit, a light is flashed as a character on the disk passes a lens. The disk never stops. Thus, the system has the potential of fairly high speeds. The Photon machines encompass quite a series, and they have, perhaps, the fullest line, as far as speed goes, of phototypesetting machines available. Their display machines, basically the Series 200, are keyboard controlled and are

capable of setting a wide variety of fonts and sizes. The 500 Series machines are tape controlled but are still classed as display machines. They are extensively used by Perry Publications for automated display advertising. The Text Master, Series 700, machines, capable of running at speeds of 30 lines per minute, are very similar in construction to the 200 and 500 Series but employ a rotating film strip which has been curved into a drum. The last in the line, the Photon 900 Series or the "ZIP," is a straight text machine capable of operating at speeds of the order of 250 characters a second from magnetic tape input. Two machines of this type have been delivered.

The closest machine to completion which will compete with the Photon Zip is the Mergenthaler Linotron, a cathode-ray tube phototypesetter. Mergenthaler has also recently announced its Linofilm with a six-level operating unit, so it is now possible to use computer tape as an input for the Linofilm. The Linofilm is a display machine, operating at about 10 lines per minute, which is capable of setting many different fonts of type with quite a range of sizes. The Linofilm has given rise to the Linofilm Quick, which is a somewhat faster machine that uses TTS tape directly. Use of TTS tape cuts the flexibility of the machine to handling only two fonts, though these are identical to the fonts used on the standard Linofilm.

Competing with the Quick and in addition to the Fotosetter, Harris Intertype has produced a machine called the Fototronic, which is capable of setting type at roughly 18 to 20 lines a minute and uses a rotating disk somewhat similar to the Photon. This machine uses a special code in eight-level tape.

Another common phototypesetter is the ATF typesetter. This is a text machine based on the Friden Flexowriter, except that it generates photographic output. Using the 18-unit-per-em Flexowriter as a base, it is now possible to obtain 18-unit fonts for the ATF typesetter. This makes the typesetter an excellent machine for "typewriter style" typesetting, where there is a great deal of quadding right and left and tabular setting, and where typewriter style tab stops and carriage returns can be used. Typewriter tab stops are, of course, a great advantage in this sort of work. ATF is now also manufacturing a machine which is intended to accept computer tape directly and so has no facility for computing its own justification.

The parent machine of the ATF typesetter, the Friden Justowriter, deserves consideration, as much type is now being set on this machine by letter shops and even by established printers. The machine is readily adaptable to computer use, as its computations for justification are rela-

tively simple and require very few, if any, characters which are not available in computer code, making the translation easy.

Lastly, there is the Alphatype machine. This is one of the few photocomposing machines in which a user can prepare his own matrices. Though it is rather difficult, several users have reported that they have done so and have been quite pleased with the results. In all of the other machines it is necessary to obtain manufacturer-prepared matrices. Unfortunately, the Alphatype uses a magnetic tape system which is completely incompatible with other keyboards and with computers. While it is possible to obtain operating units for the Alphatype which utilize six-level paper tape, none are supplied by the Alphatype company.

Now that we have reviewed the subject of the input to a computer for Graphic Arts and the output to a computer typesetting system, let us turn to what a computer can do for a typesetting system, other than speed up the justification and hyphenation operations.

With the exception of the machines that can use TTS tape directly, most of the machines which we have described are completely incompatible with each other. If you have tape which was originally generated for the purpose of setting an inexpensive catalogue on a Friden Justowriter, you are at a loss to run a better version later on a linecasting machine.

A computer can handle the necessary conversion, and can handle it easily and at high speed. Since the lines are already justified in this case, you may not want to use a hyphenation-justification program at all. On the other hand, if you do want to use it, you can change the line measure and the type font without any lessening of the quality. A computer also allows you to change the type font at will, since you can cut a perforated tape with no idea of what type font or line length the end result will be set in. You can use the same tape which you have cut originally to prepare both a pocket book edition and a limited edition, leather-bound version, running the inexpensive edition on a linecasting machine and the quality work on Monotype.

Thus, the computer is a very great aid in improving the compatibility of input and output systems in the Graphic Arts. First of all, a computer can rapidly convert between tapes and types and systems; and secondly, with the rush to automated typesetting, everyone in the typesetting business has felt that he must make his machines usable with computer tape, so the computer has acted passively as a great force toward fostering compatibility of typesetting systems. I know of no new automatic typesetting machinery which is being considered by any major manufacturer which is not completely and thoroughly computer-compatible.

Progress has been slow to date, but there is every indication that it will

not be so in the future. I believe that we can all look forward to a day when good, sound systems and hardware design will have created new standards for the Graphic Arts, standards which will make possible the over-all compatibility of input, output, and data processing systems.

THE AUTHOR

P. L. Andersson received his B.S. degree in Mechanical Engineering from the University of Pennsylvania in 1953. He began his career as an engineer at RCA in Moorestown, N. J. In 1955 he joined the Eckert-Mauchly Division of Remington Rand, then worked for the MOSD Division of General Electric, and in 1957 returned to Remington Rand Univac as a technical consultant and eventually department manager. Later he was appointed technical staff engineer at the Univac Whittpain Laboratory. In 1962, Mr. Andersson accepted a position as computer consultant and staff member at the ANPA Research Institute in Easton, Pa. In 1964, he formed his own consulting company, Andersson Associates, who are consultants and manufacturers of small digital systems.

PART IV

MANAGEMENT AND ECONOMICS

Chapter 11

EMPLOYEE UNIONS AND AUTOMATION

FRANK CREMONESI

International Typographical Union

PRINTING in the United States today is the third most important industry in the production of non-durable goods. Unlike durable steel, printing is daily *produced* and *consumed* by Americans. Printing is part of the day-to-day existence of Americans. Only *food* and *clothing* in the field of non-durable goods employ more persons than printing.

It is safe to say that Americans, the population of the world's most advanced society, survive on food, clothing, and printing.

Printing in the newspaper field comprises over 1,700 daily newspapers bought by 59 million Americans, and almost five times as many weekly newspapers purchased by 24 million.

In the field of book printing the following figures should be noted: During the first nine months of 1964, almost 14,000 new works were published, along with over 5,000 reprints or revisions of earlier works. A conservative guess is that one-half billion books were printed in America last year—one-third of which were paperbacks.

Reading has become a prime concern of educators recently. But while "Johnny" may not be able to read, Tom, Dick and Harry are devouring the printed word in prodigious quantities.

In addition, of the hundreds of magazines published weekly, bi-weekly,

semi-monthly, and monthly, 47 had circulations of over one million copies in 1964.

Add to this the many millions of dollars' worth of printing covering the full spectrum of every individual's public and private life, from name cards and personal stationery through phone books to the highest-quality slick, colored creations of modern sales promotion artists, and we can begin to understand the significance of printing in our daily lives.

Add, further, the fact that for every 2,000 persons living in the United States there is at least one printer daily earning his livelihood at keeping us inundated in printed matter, and we see how it can be said that we annually devour more printed paper than we do green vegetables.

In connection with the foregoing, one point should be made:

PRINTING HAS ALWAYS DEPENDED ON THE SKILLED

Printing, since its earliest crude forms, has been possible only because of the existence of a highly skilled, intelligent labor force, whose specialized training and skills alone have made possible the wide dissemination of knowledge through the medium of printing. This is as true in today's high-speed, high-quality printing plant as it was in the Chinese woodblock printing shop 2,000 years ago.

How did this reservoir of skilled labor come about? How did civilized society resolve to rely so heavily on so small a portion of its population? In the United States today—approaching 200 million—less than one-half of 1% of its people are employed in printing all of its reading matter—951,700 men, women, and probably children, although not likely in union shops. Of this less-than-one-million, only about two-thirds are actual production workers, and a little over 150,000 Americans are typesetters capable of converting raw ideas presented as handwritten or typewritten copy into a form ready for printing and distribution.

The explanation for this dependency of so many, and so much, on so few rests in the nature of the printing art itself.

HOW THIS SKILL EVOLVED

Let's open a few printed books for a minute or two, and see how modern printing evolved.

The birth of printing is shrouded somewhat in limited facts and in controversy, but the following facts seem fairly well established.

Paper originated with the ancient Egyptians. The transferring of images to paper began, so far as we know, with the Chinese and Japanese almost 2,000 years ago. But the making of printing ink, it is said, began when western civilization learned from the Arabians to boil oil.

Invention of Movable Type

Movable type, the most important single impetus to the advancement of printing, is said to have been used by the Chinese around the year 1000 when they printed from type characters made of clay. There seems to be no evidence, however, that Chinese movable type ever found its way to Europe.

Our age of printing begins around 1450 with the invention of movable *metal* type. Scholars in the field still disagree on whether credit for this revolutionary development should go to Gutenberg of Mainz, in Germany, or Coster of Haarlem, in Holland. In any case, we are indebted to one or to both.

The great need for printing existing at that time is demonstrated by the fact that within 20 years of the invention of movable metal type, printshops had been established in every major city in Europe.

By 1465, type had been cast to print Greek; by 1475, Hebrew was being printed from movable type. And, by 1499, music notes had been cast for printing.

By 1514—60 years after first type casting—movable type had reached the Arabic world.

It was during the first 50 years of printing from movable metal type that the printers' basic skills were established. And, while these skills have undergone a great deal of refining, they have remained basically unchanged for 500 years, up to our time.

The first type casting in America was done by Benjamin Franklin, about 1730. This celebrated printer also was first to manufacture his own ink and to build his own press. In addition, Franklin also chiseled his own hand engravings. Franklin retired at the unheard-of retirement age of 42, having advanced the printing art in America to the furthest limits of his time.

Until the beginning of the 19th century, however, the general attitude toward hand typesetting and hand press operation seems to have been that this form of printing was so far superior to the former method of writing books by hand that it needed no change.

Use of Steam Power

The first important advance of the 19th century was the harnessing of steam power to the printing press in 1810. Four years later, the first power-driven press was installed in a newspaper plant, that of the *London Times*, which hailed the innovation as "the greatest improvement connected with printing since the discovery of the art itself."

This "great improvement" seems to have stimulated research in other

phases of the art—the first typesetting machine was patented in 1822, but proved impractical. During the next 63 years, a dozen or so typesetting machines were patented but were not accepted by the trade.

Electrotype, Photography, Rotary Press

These 63 years, however, did see the birth and development of electrotyping and stereotyping, photography and photoengraving, machine paper-making, the rotary press, and finally the rotary web press printing from curved stereotype plates.

Culmination in the Linotype

This era of creative improvement in printing culminated in its greatest achievement: the Linotype, patented in 1885 by Ottmar Mergenthaler, a 31-year old watchmaker employed by the United States Government as a clock inspector and repairman.

The Linotype came during a three-year period that also saw the coming of the internal combustion gasoline engine, the motorcycle, the making of paper from wood pulp, the fountain pen, the gas mantle, the electric motor, punchcard accounting, and the only other successful typesetting machine—Lanston's Monotype.

Steel had been produced 25 years earlier, making possible the building of the Linotype. But the electric motor needed developing before it could be applied to mechanical typesetting. Steam was the first source of typesetting power, and one of the earliest uses of the automobile engine was to drive the Linotype. The electric motor was harnessed to Linotype about 20 years after its invention. This first wedding of electricity to typesetting has proved fruitful and inseparable.

A few points should be made in connection with the coming of Linotype. The machine made possible production of greater amounts of type, and therefore of printing, than ever before. It eliminated the venerable hand typesetter and his hand type as the important first step of copy-preparation.

EFFECT OF "MECHANIZATION"

In these days of concern about the effects of automation, it is well, I think, to peer into those days of earlier automation, or "mechanization," to profit from the similarities and to become aware of the differences.

We are fortunate to have an unusually reliable report of the effect of the Linotype on New York's printers in the form of a survey taken by the New York Typographical Union No. 6. The survey covered the period from 1891 to 1911—the 20 years between perfection and acceptance of Linotype, and the first readjustments to its impact. In a footnote in the *History*

of *New York Typographical Union No. 6*, published by the New York State Department of Labor in 1912, we read:

By 1894, 14 offices had installed 266 composing machines, which within a short period displaced 480 printers, many of whom were finally forced to retire from the trade owing to their inability (caused principally by advancing age) to cope with the changed conditions. Under the hand-set system these concerns had 1,455 compositors, but immediately after establishing the new method they employed but 975.

Eventually, however, these devices materially benefited the craft. In the first place they have lessened the cost of production, which has resulted in a decrease in the selling prices of publications, thereby creating a greater demand for books and periodicals, while newspapers have enlarged in both size and volume. As a consequence composing-room forces have been gradually augmented. Direct benefit has come to journeymen through reductions in the hours of labor and higher wages.

Growth of the trade is reflected in the statistics from *two* leading newspaper offices. Before those journals put in machines their typesetting departments contained 545 printers. Within six months after the installation of linotypes to the number of 90 they employed 399 members of the union.

At present the same dailies operate 143 machines and employ 685 journeymen—an increase of 140 employees as compared with the number at work prior to the introduction of composing devices.

Development of the business is also indicated in the rise of the union's membership. In 1891, when the first machine scale was adopted, previous to the general use of linotypes and other mechanical contrivances for composition, the organization had 4,487 members, while now it has 6,969 on its roster, showing a gain of 2,482 or 55.3 percent.

There were 329 printing shops under the jurisdiction of the union at the close of September 1911, and in 159 of these offices 1,277 machines were then in use, their operators numbering 1,985.

You will note that Linotype's displacement rate was about 1½ men per machine, or three men displaced by every two machines.

I suspect that any modern engineer suggesting a new machine today offering so low a rate of displacement would be fired from his job for lack of vision.

How was the Linotype greeted by the plant owners in the 1890's? There is evidence, drawn mainly from our older members who were present at the time, that the aim of many of our employers was to replace the typesetter entirely with a new breed of keyboard operator. It appears, however, that the trade generally came to the conclusion in short order that the old hand-typesetter made the best Linotype operator. It thereafter became the general practice to mechanize the hand-typesetter rather than get rid of him.

As each pair of Linotypes was installed in the 1890's, five men were directly affected: two were converted to operators and three were laid off. This continued for about 10 years, when increasing amounts of type produced by Linotype made necessary the rehiring of the displaced men along with an equal number of new men.

During those initial 10 years, it should be noted, the printing industry was undergoing displacement, too, in other directions. Newspaper press-rooms were being invaded by the recently perfected web rotary presses, said to be capable of producing as many newspapers in eight hours as required six months to produce by the old hand methods. Earlier, typesetters had begun to feel the effects of stereotyping, eliminating the need to reset great amounts of type. As a result of the sudden converging of these improvements, New York's printing industry during the 1890's resembled a kind of little Appalachia.

At the peak of the displacement period, the International Typographical Union estimated 36,000 hand compositors had been made unemployed by the machine.

New York Typographical Union at one point invested many thousands of dollars to send the printer back to the soil with farm projects. Generally, these projects were unsuccessful due to unusually bad weather at the time, lack of experience, and inability of the indoor-working printer to adjust to strenuous, outdoor labor.

An important factor with relation to Linotype was that it affected only one phase of composing-room skills, that of the initial setting of the type. Linotype did not change the important complementary composing-room operations of makeup, imposition, lock-up and proofreading. These continued to be performed in the same manner established by Gutenberg (or Coster). If anything, these preparatory operations were somewhat simplified by Linotype's slug—its typeline in one solid unit which replaced a line of type made up of individual characters.

This fact, incidentally, probably accounts for the broad acceptance of Linotype over its sister invention born about the same time, the Monotype, which cast individual characters rather than whole lines in one unit.

FIRST TENTACLES OF NEW REVOLUTION, 1947

Following the introduction of Linotype, the trade settled down quickly to stable, unchanging production methods. A major factor in this quick settling process no doubt was the fact that old, established skills continued to be applied as effectively and efficiently after mechanization as before.

And a stable trade flourished for over a half-century following the introduction of mechanical typesetting, until 1947, when there appeared the first tentacles of the coming revolution in printing. This was the coming of photographic typesetting embodied in the Fotosetter machine manufactured by Linotype's competitor, the Intertype Company.

The coming of phototypesetting offers some insight into the whims of progress. The first phototypesetting machine was intended for use with the developing offset method of printing. Photographically set type is sharp and clean, ideal for photographing on a camera. It was intended to solve problems of ink-squeeze, uneven impression, and variances in quality of type proofs.

The offset trade, however, did not accept phototypesetting. And even today, 18 years later, photo-set type is still *not* the important source of type for offset printing. Most type set for offset printing is still linotype, made useful by improved proofing techniques. "Paste-makeup" of these proofs is the standard copy preparation method for offset.

So, photo-set type floundered for about seven years, and very nearly fell into disuse. In 1954, however, it was tested on a daily newspaper as a means of producing type for grocery and other sales ads and found practical and efficient. This was not an offset operation, but the older, standard letterpress. Photographic typesetting, therefore, originally intended for use with offset, became successful only when accepted for use with the older, letterpress method. The primary users of phototypesetting today remain the big-city, letterpress-printed newspapers.

Photographic typesetting opened the way to development of the so-called "cold type" and "paste-makeup" processes. Early successes in production and economies of the cold type processes, despite limited materials and knowledge, encouraged greater use of the process and subsequent development of new equipment and materials. Today, cold type, paste-makeup is a standard part of composing-room operation in newspapers and printshops throughout the United States and Canada. It is a fully developed art, with a reservoir of skilled labor solidly founded on good training and experience, and a variety of materials and machines to work with.

But, phototypesetting did eliminate metal as the foundation type medium, using instead photographic paper or film. It marked the end of the monopoly in the printing art of Gutenberg's (or Coster's) movable metal

type. By eliminating lead, phototypesetting opened broad new vistas of potential speeds in typesetting undreamed of in the past. And with great speed as a real possibility, the natural course of development lay in the direction of electronics.

PRINTING TODAY

Let us briefly appraise printing and publishing as it stands today, and as we can expect it to function for the next few years. The fastest growing method of printing today is web offset. In 1937, there were fewer web offset presses in use in the United States than there are manufacturers of these presses today. Ten years later, in 1947, there were 28 web offset presses in the U. S. Today, there are at least 10 times that number, and it grows weekly. The manufacturing of web offset presses today is well ahead of rotary-web letterpresses that have been regarded the ultimate in perfection in newspaper production for 75 years.

Growth of Offset

In addition to producing newspapers in growing numbers, web offset presses today are printing telephone books, magazines, high-quality four-color-process catalogs, and a wide variety of printed products that a few years ago were believed printable only by letterpress.

In the field of newspapers, over-all figures on web-offset-printed newspapers are not complete. But *Editor and Publisher* announced on February 6, 1965, that there are now 167 daily newspapers being printed offset, all but six of which are produced in the United States; and their circulations total over one million. A fair guess of the number of weekly papers is that about 1,000 of these are printed by web offset methods.

The setting of text type for these papers falls into three categories: improved justifying typewriters, such as Justowriter; linotype; and the phototypesetting machines used by a few.

Hot metal type, or linotype, still offers greater flexibility in makeup, particularly in the makeup of classified advertising sections. But one reason for its continued use seems to be simply, "Because Linotype is there."

One successful small daily on the West Coast discovered it had on its hands a battery of worn-out linotypes requiring substantial expenditure to get into efficient operating order. The publisher simply decided to abolish both linotype and letterpress. He installed Justowriters to produce cold type text, a Fotosetter to set ads, and a web offset press as his printing medium. He now gets out a daily paper for five days, plus a weekend edition, with only 15 men in the production department.

The greatest growth of offset newspaper printing is taking place in the

field of private, institutional papers, usually jobbed out to commercial printers.

Most astonishing to those of us who have watched the development of the offset daily and weekly paper is that the conversion to offset does *not* seem to reduce production costs. In fact, scanty figures available would indicate that offset is actually costing *more* than letterpress.

The publisher of one such converting daily newspaper gave these reasons recently for the higher cost of offset production:

1. Letterpress plates can be remelted, while offset plates cannot and cost 90 cents apiece.
2. Mats to make letterpress plates cost 32 cents, while a sheet of film needed to make an offset plate costs $2\frac{1}{2}$ times as much.
3. Letterpress ink costs six cents a pound; offset ink costs 37 cents.
4. There is greater waste of newsprint in the offset process, and newsprint costs \$134.50 per ton.

Why, then, do publishers go offset?

There are a number of sound factors to justify the switch.

First among these is improved quality of printing and a more attractive paper, thus inviting more readers. Increased circulation is of greater importance to smaller newspapers. For larger papers, greater readership decreases in importance, it would appear, as circulation mounts. The New York *Daily Mirror* went out of business last year for lack of advertising revenue, despite a daily circulation of nearly a million. As circulation increases, costs mount and a newspaper's existence depends more heavily on advertising. For the smaller newspaper, quality of the product is important, and offset provides this.

Next, an important factor encouraging use of offset is the greatly reduced cost of illustrations. Half-toning of pictures is limited to making screened negatives; the cost of making copper or zinc plates is eliminated. Greater use of color is possible, particularly the printing of color photographs that add to the attractiveness of the paper.

Probably the most important factor urging application of offset and its companion paste-make-up is the purely business reason of advantages to advertisers. Greater latitude and almost unlimited flexibility in the make-up of ads is offered the advertiser's art department; complicated make-up can be performed at no extra cost to the advertiser. And while advertising rates are not reduced, the cost of making copper, zinc or lead plates is eliminated, as are extra costs for making BenDays and reverses.

In the early days of paste-makeup, in 1956, I recall a midwestern advertiser who hailed the coming of paste-makeup by ordering half of a full-page ad to be screened. The order would have necessitated making a zinc plate of the entire page by older methods. In paste-makeup, it involved simply pasting in screened cellophane material over the desired portions.

These, then, are some of the factors encouraging the conversion to offset of smaller newspapers:

1. Better quality.
2. Greater use of pictures—both black-and-white and color—and as more, cheaper pictures are used, less type is needed to fill the space.
3. Advantages to advertisers without loss of advertising revenue.

Finally, it should be noted that every phase of offset production is undergoing research and improvement, offering constant hope for ever greater improvements in efficiency and lower costs, not possible by the older letterpress method.

All this growth and development in offset is due in no small part to the entry into the printing industry of giant corporations never before connected with the art. For example, Minnesota Mining and Manufacturing (3M) has developed a number of pre-sensitized offset plates and a broad variety of new materials. The DuPont Company has developed a whole array of photo materials and chemicals in addition to its Dycril plate adaptable to either letterpress or dry offset printing. These are two of the newcomers to printing. Among the veteran printing suppliers, Harris-Intertype now manufactures a wide range of presses and plates for offset; Miehle, the pioneer cylinder press manufacturer, not long ago ended production of letterpresses to devote itself exclusively to building offset presses.

But let us move to other new developments.

Introduction of Electronics

Probably the most dramatic innovation in printing is the introduction of electronics during the past few years. Devices driven by the darting electron are now available to:

1. Set type photographically at speeds up to 300 lines per minute.
2. Read perforated tape operating high-speed linecasting machines.
3. Control color register on presses running at high speeds.
4. Deliver rolls of newsprint to presses.

5. Count and bundle newspapers coming off a press and deliver them automatically to trucks standing at the loading dock.

Computers as part of typesetting are a recent innovation, not two years old. General- and special-purpose computers have been installed in some 125 printing and publishing plants. At present, computers serve to justify and hyphenate the intractable English language, with varying percentages of success.

But the greatest potential for computer use rests at present in the minds of electronics engineers, and the direction is toward harnessing computers to phototypesetting to perform both typesetting and makeup work. Application for patent has been made for one such combination computer-phototypesetter, said to be capable of photographically setting type at 4,000 characters per second.

A glimpse of the future is offered daily by *The Wall Street Journal*. Each morning a battery of tape punchers goes to work producing tape to activate high-speed Linotypes. The tape is placed into data transmission telephone lines, and identical tapes are simultaneously punched in a half-dozen cities from Massachusetts to California. Repunching is accomplished at the rate of 100 characters per second, about 200 lines a minute, roughly one page in six minutes.

The repunched tape is inserted into linecasting machines in the six cities, where type is set, pages are made up, plated and printed.

In San Francisco, a proof of each page is placed on a closed TV transmitter and sent by electronic airwave to Los Angeles, 350 miles away. The page image is picked up on film, the film is processed, plated, and printed to produce the Los Angeles edition of *The Wall Street Journal*.

By this method, it is now cheaper, faster, more efficient to reprint a whole edition of a newspaper than it is to ship it 350 miles. This is the facsimile transmission process, first experimented with by the Japanese, and now promising to create a network of national newspapers.

PREDICTIONS FOR THE FUTURE

It is not foolhardy to predict the American of the future will be reading a national newspaper for news, and a small, local paper for the latest department store bargains.

The future of electronics promises high-speed computer-operated phototypesetters pouring out type at a rate of 5,000 or more characters per second, set and made up—a full newspaper page made up in a few seconds—a full 60-page newspaper in minutes, on film, ready for plating and

printing—either letterpress or offset. And if one prediction comes true, the film itself can replace the plate on an electro-static printing device, printing at the speed of electricity.

But all this is some distance away.

In the immediate future, we can look to more numerous applications of computers. Today, in the publishing industry, they are installed almost exclusively by the larger, more affluent publishers. Computers are expensive equipment. Larger, general-purpose computers cannot justify their cost as exclusively typesetting assistants, so they are installed for typesetting functions only where they can also be applied to automate office operations.

This is significant because the printing industry is still basically an industry of comparatively small plants. There is nowhere in printing a plant of the magnitude of an auto or steel plant, although printing employs more people than either industry.

We can expect, therefore, smaller computer applications—the “desktop” computer. We can expect, too, the growth of the centralized computer providing service to many shops, and connected to those shops by data transmission telephone lines.

The computer, and its electronic sister, the photoelectric cell—the “electric eye”—will be applied to more and more printing and publishing operations, from the reading of typewritten copy to delivering of the printed matter.

New fields for high-speed typesetting and printing will open up in our age as they did following the advent of Linotype. It is estimated today that one billion typewritten pages are produced monthly by computer printout. Most of this printing was impractical or impossible in the past and is completely new copy. High-speed typesetting can bring to this new field much needed improvement in quality and readability. It is a market waiting for the right price.

The whole world of communications is being transformed by electronics. It is reasonable to foresee a time when newspaper plants will not print newspapers at all, becoming instead centers of specialized information available to anyone for a small fee. The unemployed programmer looking for a job, the housewife seeking a shopping bargain, the service club member wondering if the Lions are meeting tonight, the doctor faced with a peculiar set of symptoms, and, of course, the speech-writer looking for a few impressive predictions—all will dial the local newspaper and get their answers instantly on a TV screen on the telephone. Centers of information throughout the world will be connected by controlled electrons instantly providing data on everything from the most advanced scientific informa-

tion and calculations, to, conceivably, the location of the nearest Bunny Club.

This, then, is a glimpse of the world to be created by automation and change in our world of communications. And I stop here to avoid sounding too absurd.

FACTS—FOR OVERALL VIEW

No report of this nature is complete without some figures to provide an over-all view. Of course, we recommend all the usual cautions applied when examining figures. But a brief comparison between wages and productivity offers some insight into the advance of technological improvements. Unfortunately, the most recent year's figures available are for 1962; those for 1964 would be higher in view of the constant rise since the end of World War II.

In 1962, there were 20% more production workers in printing and publishing than in 1950. But the value added by manufacture to the printed product increased five times as much, or 103%.

Weekly earnings per production worker during this same 12-year period increased 44%. Put another way, while 100 persons were required to produce 100 pieces of printed matter in 1950, only 120 persons were needed to produce 203 pieces in 1962. And while production employees doubled their productivity in 12 years, their average weekly earnings increased from \$71 to \$103—44%.

Incidentally, one of the significant, though not analyzed, facts about our industry is that it employs almost the highest percentage of non-production and supervisory workers. In 1950, 34% were non-productive; in 1962, the percentage increased to 35.3%. And last year, 1964, the percentage of non-productive employees in printing rose further, to almost 37%. In this respect, printing is surpassed slightly only by the chemical and petroleum industries.

So much for figures.

CAN WE MEET CHALLENGE OF ELECTRONICS?

Change breeds fear, someone has said. And great change can be expected to bring great fear, made hopeless by confusion. Appalachia offers ample ground for these fears and for confusion.

Another Appalachia?

Appalachia exemplifies the application of the most advanced engineering knowledge and techniques to the solution of production problems, with a total disregard for social consequences. The result of this lopsided

application of knowledge has been economic devastation in the midst of one of the most productive areas in the nation. Only a little over a decade ago, Appalachia was a prosperous community.

Why was it prosperous then and not now?

The reason can be stated ironically: "Because then they needed three times as many coal miners to produce only half as much coal."

This is the paradox of today's progress. With the exception of very few among us, we do not find much reason to be encouraged by the prospects of automation—this too is a paradox. A century ago, the mechanical revolution made its goal the placing of machines into the hands of men, adding to their muscle, extending the effectiveness of their skills and experience. The man displaced by a machine at that time found some solace in the prospect of getting a job in the plant manufacturing the machine that had displaced him. Things tended to even out.

Today's revolution is quite different. It starts with the first objective of eliminating the man—or, more accurately, its first objective is to eliminate men in large numbers. And after the man is eliminated, there is no job at the plant making the machine, because that plant, too, has been automated.

Some Approaches

In this perplexing social picture, there exists today only one major force exerting any influence to prevent a repetition of Appalachia. That force is the Labor Movement. Only our unions today concern themselves with preventing the kind of irrational economics that says, "We make progress only to the degree that we can eliminate jobs."

Employers installing automated equipment simply ignore, and sometimes resent, any suggestion that they should be concerned with social consequences. The Government makes noble efforts, but only after the fact, that is, after men are unemployed.

There is a class of employers who believes it has found the solution to prevent dislocation, and this group should be noticed if for no other reason than because it is concerned with social consequences resulting from automation. This class recommends as its solution guaranteeing the jobs of men on their payrolls and hiring no new men. This, of course, is attrition. Neither the public nor the labor union can be expected to accept attrition.

Why?

Simply stated, attrition is slow death in peaceful society as much as it is on the battlefield. For the printer, it means simply eventually a printing industry without printers—a form of planned annihilation.

The great need of the moment is to re-examine present ways of thinking, re-examine with the resolve to change, whenever necessary, values and

standards we have inherited from the past. The problems we face today were unknown in the past, and solutions of the past simply are irrelevant. Not long ago, in my home state of Colorado, a man accepted as inevitable the possibility he would die suddenly of gunshot. As the nation grew, and civilized standards replaced the earlier values, men gradually came to accept the inevitability of earning a living in industry in place of sudden gun death or long life on a ranch. This inevitability of industrial livelihood is now disappearing. Can we build among our people a new expectancy of spending a life in the social services—in medicine, psychology, social work, and all the sciences evolving to make man's life fuller? This, I think, is the real challenge of our times. Our democratic society has evolved so that we have all become English weavers who will fight devastating social conditions. But we have learned to use democratic weapons—we form unions, and groups, and movements. We are no longer satisfied to throw a single shoe into a weaving machine to save only one job. We will organize a million men, a hundred million men, to save a hundred million jobs for men with families and with aspirations and with a burning desire to participate in progress.

At this moment, we are not faced with an immediate upsurge of social forces. We *are* faced with gradual development of little Appalachias, particularly in the printing and publishing industry. How can we meet the challenge? How, in short, can we succeed in making progress orderly at a time when every engineer is, in effect, plotting a revolution?

WHAT ITU IS DOING

I can report what the International Typographical Union is doing.

We have attempted, in a number of ways, to fill the chinks in the dike, preventing the flood of economic devastation.

About 10 years ago, at the beginning of the revolution in printing, the ITU set up its New Processes Training Center. Its purpose was the retraining of the printer in any new method. This revolutionary approach was initially taken because phototypesetting, unlike earlier linotype, not only changed basic typesetting, but changed all subsequent complementary composing-room operations as well. In addition, phototypesetting combined a significant part of makeup with initial typesetting, importantly reducing the time between receipt of copy and production of a made-up form.

Since those early initial classes in phototypesetting and paste-makeup, the ITU Training Center has grown as new processes have grown, up to its present facility in Colorado Springs comprising 2½ million dollars in building and equipment. Its graduates have set up local training centers in

over 100 cities throughout the United States and Canada. These local schools in turn have provided training for our smaller locals in over 650 more cities and towns. This network of available training has created a condition unique in human history: it has produced a reservoir of available skilled labor in every city and town where printing is produced, labor skilled in processes not yet introduced in those towns. It is as if, by some miracle, at the moment movable metal type was invented in 1450, there sprang up a reservoir of skilled printers in every hamlet in Europe. We can well imagine the influence on civilization flowing from such a miracle.

From the beginning, the ITU has taken the position, as a matter of policy, of encouraging every form of progress—even to the extent of actually creating, patenting, and distributing to the trade five of our own new machines and processes, with patents owned by the ITU.

The result has been a transition to new methods of production in literally hundreds of printing plants, large and small, with a smoothness and freedom from dislocation unknown in any other industry at any time.

In the field of safeguarding against the unknown potential, the ITU has recently begun to strive for a share in the savings produced by new processes, so as to provide funds to encourage earlier retirements, funds for retraining, funds for unemployment benefits. The ITU has insisted on, and obtained, the shorter workday and expanded vacations. This is a modern application of an earlier technique tested in the 1890's when the ITU established the first eight-hour day among Linotype operators.

The ITU and its Training Center provide for today's skilled printer and, very importantly, for his employer, the strongest assurance either has that he will be part of the printing industry in the future.

It is offering the printing and publishing industry an asset never enjoyed by employers in any age of progress: a trained work force ready to skillfully handle any new machine or process he may install, a skilled work force with 500 years of experience and know-how in the printing art to give breadth and depth to its work.

In this connection, you will be pleased to hear of two recent developments in the Training Center's metamorphosis.

First, we have just concluded an arrangement to bring advanced electronic knowledge and training to every printer. This is now available in the only practical way for so vast an undertaking—by correspondence course.

Second, beginning in the last week of this month (May, 1965), our first class in computer programming and operation opens in Colorado Springs.

The ITU is suggesting a world in which all the people can benefit by automation; it is creating an atmosphere of acceptance of automation with the assurance that progress will benefit, not devastate. In sum, it is *encour-*

aging automation in printing as a means to greater dissemination of knowledge through the medium of the printed word, and broadening that knowledge by application of new principles to meet social needs.

In the application of our policy, we approach our employers without rancor or threats, we make one simple demand—that the printer rooted out of his place in the composing room be given the first opportunity to perform the process displacing him. And we take the responsibility for training in the process!

Printers are a special breed of men. They are skilled workmen and are proud of their skills and achievements. They contribute daily to human progress and are jealously conscious of their contribution. They descend from men whose names sparkle in the pages of human history, and they have built the world's most democratic organization to protect themselves.

As the printer stands in the doorway of the future, he is convinced he is *best* qualified to do the *best* job of providing humanity with the best vehicle to keep it moving forward—Printing. And he is determined to produce printing in the future, in whatever form.

“MEN OF GOOD WILL”

No problem is insurmountable if attacked by men of good will working together. We believe we are men of good will who have demonstrated that good will in every way it can be demonstrated by a progressive, far-sighted trade union. We ask all others of good will in the industry to join us in meeting the problems now in gestation, before these problems are born. Union printers ask only to be permitted to help solve whatever problems may arise—from *inside* their printing trade.

THE AUTHOR

Frank Cremonesi has worked in the printing trade since graduating from trade school in Bayonne, N. J., in 1930. In 1956 he joined the staff of the new training center of the International Typographical Union in Indianapolis and in 1960 was appointed Administrator of the ITU Training Center in Colorado Springs, Colorado. He is a member of the Indiana and Colorado Bar.

Chapter 12

ECONOMICS OF AUTOMATED PRINTING

ARTHUR E. GARDNER

Director, Composition Information Services, Inc.

NEARLY THREE YEARS have now elapsed since the hand of advancing science opened the commercial composing-room door, threw in a digital computer, and sparked an unprecedented level of constructive chaos in the field of typographic communication.

What has happened during the intervening months is amply recorded in the pages of trade journals throughout the world. The expanding application and continuing refinement of computerized typesetting persist.

The number of computer manufacturers associated with the typesetting application increases, and the intervals between announcements of further research, new equipment, and additional installations seems to steadily diminish. According to the latest periodic CIS Survey of Computer Users, 121 general- and special-purpose computers are being used to handle composition assignments. This multiface new marketplace now finds a dozen computer manufacturers courting the composing room.

During the past few years, we have seen the movement of typesetting technology from a traditionally stable—or stagnant—mechanical craft into a rapidly changing and expanding science engaging principles of electronics, optics, photography, data processing, and other previously alien disciplines. Amid all this movement from sweat to sophistication, more efficient

systems of printed communication are gradually evolving from the cooperative assault on the problems of typesetting by experts in both printing and electronics. For years, a large segment of the electronics industry has recognized the data processing nature of composition requirements and its suitability to the application of such concepts as storage, updating and correcting, information sorting and categorizing, and indexing. Now, finally, these techniques are being realistically explored and cooperatively exploited.

WITH COMPUTER COMES REVIEW OF THE SYSTEM

Whether history records the composing-room computer as comparable in impact to such milestones as movable type or linecasting, only time will tell. Of far greater significance at the moment is the fact that computers have vividly emphasized the necessity of conscientiously reviewing the economics of both old and new processes as complete systems, not simply as individual machines.

We are slowly beginning to observe the application of the systems, or integrated data processing, approach to composition. This is essential, for it will be the computerized *system* that lowers composition costs, not the computer per se. The printing and publishing industry, and the composition segment in particular, has now been given the admonition and incentive to stop contemplating its own individuality and start realizing its similarity to other data processing industries.

SOME MOTIVATIONS BEHIND AUTOMATION

While the basic technology behind the automated typesetting application is not new, some of the motivating forces driving its introduction, development, and increasing acceptance are worthy of attention.

Apart from the perennial problems of labor's "insatiable economic appetite" and the universal cost/price squeeze, the growing shortage of skilled personnel has stimulated management interest in typesetting automation. By way of illustration, finding competent TTS operators in adequate numbers has been extremely difficult. Computer orientation, which serves to reduce the specialized skills and training required to produce input for typesetting control, has provided a means of widening the base of available keyboarding personnel.

The inroads of faster, more versatile and costly typesetting machines have served to focus on the inefficiency of the one-to-one, man-machine relationship that has characterized the majority of typesetting production. Computerization brings with it the opportunity to better utilize the inherent productive abilities of both conventional and advanced composition devices.

Following two decades of rather marginal acceptance, phototypesetting has been given renewed impetus as a result of the new era in typesetting technology. Electronic speed and versatility have started to capitalize on the intrinsic, untapped ability of photographic techniques to pursue such advanced procedures as automatic page makeup and display advertising.

Another stimulus for the application of automated techniques to composition operations stems from the increasing role of computer-generated information in science and industry. Rapidly growing volumes of computer output would be usefully directed toward the typesetting industry as soon as it became possible to economically and expeditiously convert such data to proper printed form.

Just as the radically increased efficiency of the linecasting machine tremendously increased the volume of composition activity three-quarters of a century ago, the computerized typesetting system will again expand the scope of material which can be economically typeset.

While computers bring to the composing room no new skills nor the capability of doing anything that is not already being done by human hands, the computer can do virtually all of typesetting's repetitive tasks infinitely faster, more accurately, and, we hope, with significant cost savings as compared to manual operation.

It is regrettable that the *publicity* of automated typesetting promise and progress has traveled at about twice the speed of practical application. The "glamour" of computerized composition, the lack of a uniform basis for comparison, and the too-often overly subjective desire to bypass labor problems have helped to generate a wealth of ill-advised, misleading and inconsistent reports concerning the economics of this emerging technology.

In many instances, economic feasibility studies have not compared existing operations on the most efficient basis attainable before determining the savings available with new processes and new equipment. Pay-out calculations will necessarily vary from plant to plant, depending on both the system currently in effect and the level of productivity.

It is understandable that the percentage of savings attributed to computerized typesetting have run from one extreme to the other, depending largely on the base from which such comparisons were made. A review of production data publicized over the past few years provides some interesting, if not disturbing, revelations.

Virtually all of the available figures relate to the perforation of unjustified tape as compared to justified tape. In most instances, production speeds have been expressed in terms of lines of newspaper length, i.e. 10½ to 11½ pica lines containing approximately 30 characters.

Reported speeds of unjustified tape perforation of straight matter for computer input have ranged from less than 300 lines per hour to more

than 700; or, expressed in terms of keystrokes, from some 9,000 to over 21,000 keystrokes per hour. As compared to justified TTS tape preparation, the reported percentages of increase have ranged incredibly from 8% to 75%. The influence of typesetting automation in other areas shows similarly wide disparities. And, most of the current reports do not clearly relate productivity gains to the added costs occasioned by the use of automated equipment.

THE ECONOMICS ARE HARD TO ASSESS

In essence, because of the incomplete statistics, seeming inconsistencies and widely differing experiences, it has, to date, been very difficult to assess the true economics of typesetting automation. Factors beyond dollar savings, such as the pressures of available time, or certain other expediences, have also provided motivation for maintaining computer installations.

Based on the ease of initial application and subsequent analysis, the users of special-purpose computers have, to date, found it possible to show specific savings more readily than general-purpose users. It is, however, premature to reach meaningful conclusions until the application of both techniques are refined. Depending on individual conditions and requirements, objective cost/capability studies will no doubt find practical applications for both the limited and more versatile computing devices.

Whereas automatic hyphenation and justification capability alone has provided incentive for newspaper industry involvement, and certain special-purpose computer applications, the available facts are beginning to indicate that computer use will have to extend beyond justification if it is to do more than break even with an efficient, conventional TTS operation. This is particularly true in the case of commercial, as opposed to newspaper, applications.

It is also being realized that the perforation of computer input tape, *per se*, is not necessarily synonymous with keyboarding improvement. Unjustified tape is not inherently more efficient than justified tape. As more complex typesetting tasks are tackled, the "idiot" tape must become increasingly educated. The nature and extent of such extraneous control coding can quickly negate the economy of subsequent automatic processing.

Composition operations must be viewed in terms of *total* costs in order for the economics of electronic orientation to be realistically determined. A stated composition production increase of 20% via automation may, for example, relate only to original keyboarding and therefore represent a far smaller saving when compared to the total composition cost of a particular job. It also becomes important to insure that the savings obtained in one facet of production do not adversely influence the efficiency of other operations.

While specific production statistics remain scarce, automated typesetting experience has served to emphasize that it invariably takes more time, effort, and money to get off the ground—and stay aloft—than is initially anticipated. In addition to the basic rental or purchase price of new equipment, other expenses can include higher initial labor costs, space and facility preparation, personnel training, additional maintenance requirements, attrition costs, parallel operation expenses, etc.

Total system cost analysis must also include necessary peripheral or auxiliary equipment. In the case of planned departures from the “standard” automated typesetting packages, it is essential to anticipate the high cost of programming. With hardware available at increasingly attractive prices, further progress of computerized typesetting is in a very real sense dependent on the economics of program development.

BUT “WHEN THE DUST CLEARS . . .”

Those organizations now pursuing composition automation beyond hyphenation/justification are experiencing the inevitable experimentation costs of all pioneering ventures. When the dust clears some years hence, composition operational patterns will have been revamped into more logical, rational sequences.

The hard facts of economic life will have removed many of today’s “strait jackets” of tradition and tired tools that now prevent optimum use of the computer in the composing room. Relationships between purchasers and producers of typographic products will have to be redrawn to eliminate many of the unnecessary production steps and to lessen the wasteful practices that now impede the most economic approaches to composition automation.

As development gives way to practice and reliable cost comparisons become available, the wider implications and economic applications of computers to typesetting and related information management assignments will become increasingly apparent.

THE AUTHOR

Arthur E. Gardner is the founder and director of Composition Information Services, Inc.—a management organization devoted to typesetting production and technology. Prior to the establishment of CIS in 1964, Mr. Gardner was technical director of the International Typographic Composition Association. Earlier printing experiences range from an ITU apprenticeship to various production management responsibilities.

A graduate of the printing management program at the Rochester Institute of Technology, Mr. Gardner is the author of many publications, and in addition to editing the biweekly *CIS Newsletter* he is a frequent contributor to professional journals both in the U.S. and abroad.

Chapter 13

A GRAPHIC METHOD OF ECONOMIC FEASIBILITY ANALYSIS^{1,2}

EDWARD J. FORBES
National Bureau of Standards

INTRODUCTION

THE PRIMARY PURPOSE of this paper is to show the utility of a straightforward graphic method of presenting the results from computer composition production experiments and engineering analyses. A secondary purpose is the presentation of the information developed to date in the expectation that this will motivate others to communicate the results of their experimental work and their careful estimates for critical technical review and discussion. The reader who has not had sufficient production experience in the characteristics of work in a job shop environment is cautioned against the temptation to extend these economic feasibility conclusions by simple extrapolation of the information contained in this paper.

In the first part, the information-handling environment is identified by tracing the flow of information through each work function in proper sequence. Then, after covering well-known cost formulation fundamentals

¹ Contributions of the National Bureau of Standards are not subject to copyright.

² Manuscript keywords: computer typesetting, photocomposition, cost studies or economic feasibility, printing, estimating complex keyboarding, micropublishing.

for printing and binding, we proceed to the more difficult task of estimating the composition cost (pre-offset negative preparation of information) and then compare relative costs for comparable production work functions.

In the second part, performance characteristics of two new types of high-speed photocomposers are summarized. The direct production unit cost for the more powerful machine is shown graphically to illustrate that such a machine's performance can be considered as the functional equivalent of the process camera (fully prepared information to offset negative).

Finally, in the third part, results of an analysis of production feasibility for computer photocomposing a large document center's announcement journal and four alternate indices are shown. The purpose is to illustrate the cost feasibility. This can be done by graphically presenting the results of a thorough engineering analysis of production costs for a projected computer composition system.

METHOD OF ANALYSIS AND USE OF CURVES

To set the stage properly, Figure 1 shows the large number of work functions which are relevant to the flow of information through the produc-

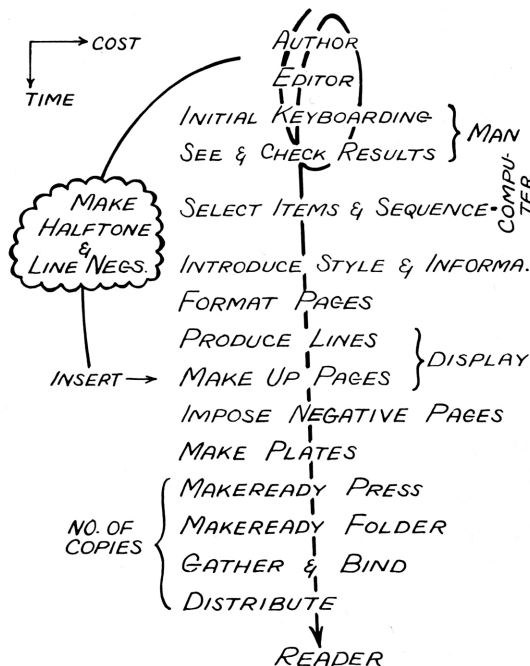


Figure 1. Production process flow of information from author to reader.

tion process. Especially note that the initial flow of information usually cycles more than once through the first 10 steps of initial preparation and correction, before proceeding into printing production and eventually on to the reader.

If one is to compare the cost-effectiveness of any two equivalent systems, one must be aware of the flow of information from the author (point of origin) all the way through to the finished product in the hands of the reader. Obviously, the dynamics of time and cost interact. For comparison purposes, by using graphic techniques, we can display relative time and cost analysis results simultaneously, thus showing for each work function the time in process on one axis and the cost (by area) on the other axis.

Eighteen months ago I developed the easily defined and understood printing and binding cost estimating curves illustrated in Figure 2. Accuracy of this method was tested in December 1963 and January 1964 and found to be within 10% for 77 computer- and typewriter-prepared jobs. These curves are based on fully prepared camera-ready copy submitted to the offset printing and binding plant. They cover all-inclusive make-ready and running costs for three types of printing equipment, including the cost of using a popular 100-lb. offset paper. However, these costs have not been adjusted to bring them up to date as a current planning tool.

To illustrate this graphic method, consider a 400-page book for two proposed levels of production: 2,000 copies and 4,000 copies. Referring to Figure 2, we see that 2,000 copies of one page cost about \$5.00 and 4,000 copies cost approximately \$8.00. Therefore (multiplying by the

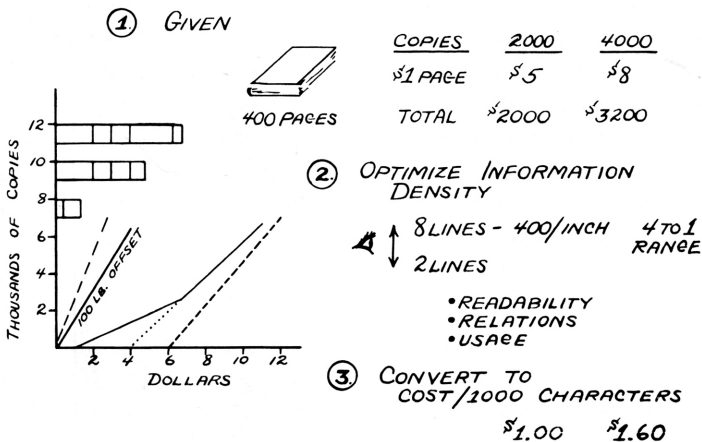


Figure 2. A chart for estimating offset printing and binding costs when camera-ready copy is furnished.

number of pages in the job), 2,000 copies of the 400-page self-covered publication can be offset printed and bound for an estimated \$2,000, and 4,000 copies for \$3,200.

Up to this point nothing has been said about the information density determined by the style or format specified for a typical printed page. Since the human eye perceives small type information over about a 4-to-1 size range (style)³, considerations of readability, usage, and the relationships required for indicating different information elements are basic as the publication designer tries to optimize the information density. Variations in printed character density and style for a given page area may vary the number of pages, and therefore the job printing and binding cost, within an over-all 16-to-1 range.

It therefore follows that if the designer places twice as much information on a page at no reduction in readability, he will need half as many pages and hence will cut the printing and binding costs in half.

After the information density (style) is established, it is very useful to convert the dollar cost per page for printing and binding into *printing and binding cost per 1,000-character unit*. If the hypothetical 400-page publication averages 5,000 straight-text information characters a page, 2,000 copies printed and bound will cost \$1.00 per 1,000 straight-text information characters, and 4,000 copies will cost \$1.60 per 1,000-character unit.

This conversion to cost of printing and binding per unit (1,000 information characters) will later be extremely helpful in comparing old and new relative job costs which include printing and binding plus composition, which is customarily sold in 1,000-em units. Obviously, the cost evaluation problem is to find a common unit relating apples and oranges—the one-time preparation cost and the cost of printing many copies.

The buyer of “composition and printing” wants to know what his job will cost. He may soon start defining his computer-prepared job as “W” copies of “X” units (1,000 information characters) to “Y” type density and “Z” style and format specifications.

Now let us consider the much more difficult task of estimating composition costs per 5,000-character page (see Figure 3). To the left of the heavy vertical line at the graphic zero point are shown composition costs for alternate methods in dollars per page for 5,000 straight-text characters. A typical typeset page was assumed to be 5,000 straight-text characters. To the right of the heavy vertical line (zero point) are shown three alter-

³ This range seems to be related to the generally accepted 8 lines/mm maximum resolving power of our eyes and the loss of information down near 2 lines/mm.

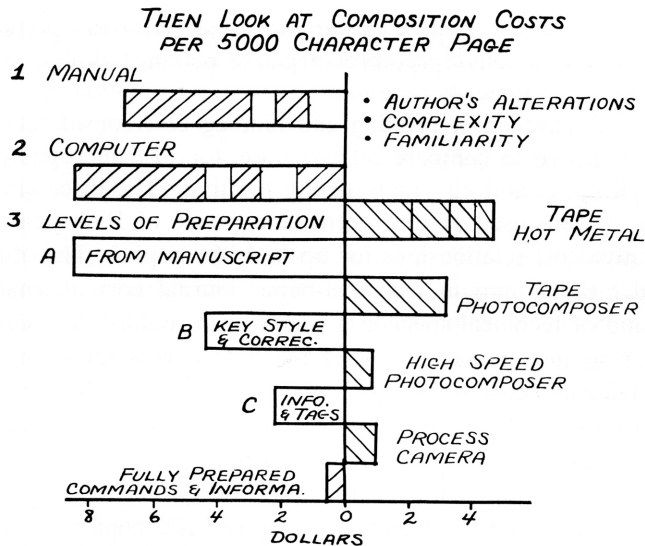


Figure 3. A comparison of manual and computer preparation costs.

nate tape composers accomplishing the functional equivalent of the process camera, from fully prepared tape, making an offset negative.

The top left bar of Figure 3 shows manual keyboarding, proofreading, correction keyboarding, and Justowriter automatic retyping costs for preparing camera-ready copy.

Underneath is shown a bar estimate of work function costs for processing the same 5,000 *straight-text* information characters through a computer, producing a fully prepared tape. If the cost of straight-text composition, the \$7 bar left of zero in Figure 3³, is added (zero points superimposed) to the multiple-copy cost curve in Figure 2, it is then possible to predict and graphically visualize the dynamics of the complete composition, printing, and binding costs per 5,000-character page.

If we divided our page cost by 5, a new horizontal scale could easily be added to show combined costs of composition, printing, and binding *per 1,000-character unit* of information. Relative significance of various cost elements can be seen as this cost of composition, \$6.00 to \$7.00 per 5,000 characters (or page), is visually added to the printing and binding costs of \$5.00 to \$8.00 a page.

For the more complex information which is to be typeset, it is clear

³ The two transparencies (Figures 2 and 3) are superimposed on the overhead projector.

that *most of the job costs exist in the composition or preparation for printing work functions (pre-offset negative making)*, unless a very long run (number of copies) is required.

Before we leave offset printing and binding cost considerations, it also will be instructive to compare relative costs for (1) micropublishing, (2) office duplicating, and (3) high-quality printing. The three curves shown in Figure 4 were used at the recent Conference of Biological Editors to show relative cost relationships for up to 1,000 copies. The objective was to consider the minimum technical-paper journal cost alternatives for a small group of technical specialists who wish to publish and communicate their work to their associates. Clearly, these curves show that this minimum publication cost objective could be achieved only if the scientific author-workers were willing to take full responsibility for carefully preparing camera-ready copy to well-defined standards.

The relative costs are three cents a page plus 20 cents per 100 copies in microform, \$1.00 per page plus 25 cents per 100 copies for office duplicator quality work, and \$4.00 per page plus 10 cents per 100 copies for good-quality press work.

Although these duplicating and binding cost relationships are meaningful, we cannot overlook the necessity for someone to do the preparation (composition). These costs would normally be *at least* \$7.00 per 5,000 characters, or one page, for a quality typeset journal.

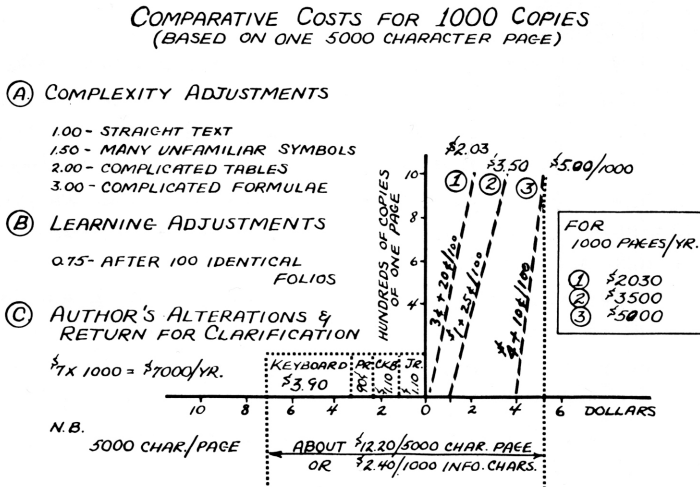


Figure 4. Relative costs of micropublishing, duplicating, and good quality printing.

Figure 4 emphasizes again the need to analyze the copy and its information content, considering the three complexity adjustment factors shown. For estimating composition costs, the required complexity adjustment multiplier will vary from unity for straight text to over three for very complex formulae. Thus it is easy to see how the normal \$7.00 per 5,000-character-page can become \$21.00 or more per page for a quality typeset journal.

After becoming familiar with these graphic displays, I hope you can see opportunities for even more extensive use of such techniques. Individual "elements of the cost" bars and curves may be visually adjusted on the basis of actual job experience and then can be used to estimate the unit cost of alternate tape composing machines. Visual comprehension of the system dynamics then becomes possible and alternatives can be more rigorously discussed.

If these visual graphic estimating techniques are used on a computer-lightpen-cathode-ray-tube display system such as the MAGIC console at the National Bureau of Standards, estimating and evaluation of alternatives could be improved in speed and with adequate accuracy. Obviously, similar graphic techniques can be used for "time in process" evaluations. Then a combined graphic cost-effectiveness display system could be developed with time in process for each function on one axis and cost (by area) on the other axis.

POSSIBLE ECONOMIC PERFORMANCE OF NEW HIGH-SPEED TAPE PHOTOCOMPOSERS

Over the last few years the application of digital information-handling and control techniques to new graphic information display devices has advanced the state of the art to a point where we may seriously evaluate the possible production performance of the first of a powerful new generation of high-speed photocomposers that produce typographic-quality output. Figure 5 illustrates the main characteristics of two representative new high-speed photocomposers.

The upper sketch shows the 200-character-per-second Photon GRACE "line-at-a-time" photocomposer. This production prototype has been operating routinely to compose an 800-page monthly publication at the National Library of Medicine since August 1964. The lower sketch illustrates the 1,000-character-per-second Mergenthaler Linotron page photocomposer, which is to be installed at the U.S. Government Printing Office in March 1966. This system also has the technical potential for the addition of an illustrations-handling subsystem at a future date.

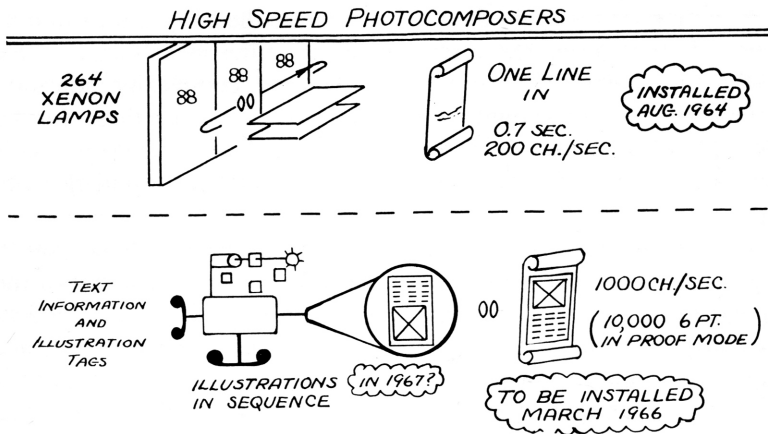


Figure 5. Functional characteristics of two new types of high-speed photocomposers.

In the Photon GRACE system at the National Library of Medicine, the individual information characters or symbols are flashed one at a time as the lens moves across the film. Currently this system performs at a basic speed of about one line in 0.7 second. Presently this display is limited to a choice among 264 individual character shapes which cannot be changed in size. In the future it is possible that new character shapes may be accomplished by manually replacing one or more of the three 88-character grids. The limitation in typesetting flexibility is not significant for many computer list applications which have previously been of both poor readability and low information density. These applications are usually produced on electromechanical line printers with about one-third that many symbols, each of considerably less than graphic-arts quality.

When one considers that this Photon machine delivers, after film processing, a film positive which is easily gang-contact-printed and processed to make offset negatives, it is clear that it has a throughput time competitive with much faster computer electromechanical line printers. As inherent photographic-optical limitations are minimized, machines of this type may be expected to be economically applied to the publication of computer-prepared directories similar in style (appearance) to the *Index Medicus* for which the Photon machine was developed.

The lower sketch illustrates the main functional characteristics of a more powerful and more costly Mergenthaler-CBS Laboratories cathode-ray tube display system being designed and produced for the U.S. Government Printing Office and the Air Force Logistics Command. This system has

two outstanding features. The CBS Laboratories' invention of a 256-aperture character generator tube makes possible high-speed character selection (with 3-to-1 variation in point size) and precise location display of an individual character anywhere within the 8" x 10½" film image area of a high-resolution display CRT.

Since both of these machines have been described in detail in earlier papers at this Institute, no further time will be spent describing how they work, other than to point out that character-processing by computer to prepare full-page display can become quite complex if the typographic style requirements are complex and change frequently.

Considering only the cost elements between mounting a fully prepared magnetic tape and delivering a reversal processed offset negative, the future economic utilization for such a very flexible and fast page photocomposer may be estimated and plotted as shown in Figure 6.

Because of the high initial cost, such a system must be heavily used if it is to compete directly with the process camera for offset-negative-making from fully prepared information. A quarter million 5,000-character pages of composition per year appears to be about the break-even point. Obviously, a lower-capacity but somewhat similar curve could be constructed for the GRACE system or for the other, slower, paper tape machine systems commercially available.

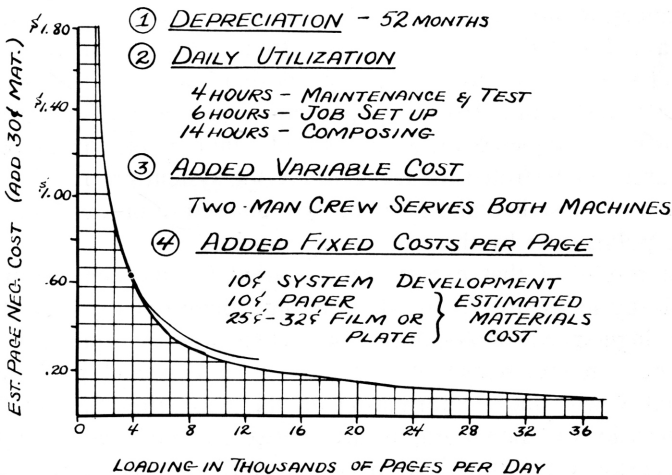


Figure 6. Estimated page unit cost variation for a very-high-speed photocomposer as a function of loading.

EVALUATING BY-PRODUCT PRINTING FROM THE CREATION OF AN INFORMATION RETRIEVAL FILE

All of the big libraries and technical document centers have the problem of promptly announcing, with alternate indexes and subject descriptors, the important monthly additions to their collection. The more modern Federal Government systems which routinely produce MEDLARS at the National Library of Medicine, the *Technical Abstract Bulletin (TAB)* at the Defense Documentation Center, and *U.S. Government Research and Development Reports (USGRR)* at the Federal Clearinghouse for Scientific and Technical Information make extensive use of general-purpose computers for bibliographic information retrieval. In each case the basic information retrieval file is built by a one-time keyboarding, proofing, and correction of the file of information, which can then serve the purposes of both information retrieval and printing.

Over a period of years the building up of a master citation file with subject term descriptors will make possible retrospective search and bibliographic retrieval of vital documents which otherwise are not likely to be recognized as pertinent within such a very large collection. Since these publications require roughly two-thirds of the information entered into the master tape file record of a document, selected information for printing need only be rearranged and tagged for style by a special "insertion" computer program. This prepared information can then be computer photocomposed and published.

Eighteen months ago, the number of copies required for various parts of *TAB* and *USGRR* varied from 6,000 to 16,000. The combined information retrieval and printing requirements therefore were sufficient to justify the performance of a 16-page production experiment. The experiment was successfully completed on a slow-speed Linofilm photocomposer in June 1964 and demonstrated the feasibility of the system proposed. This system may soon be installed and probably will be used to produce the first section of the publication by the end of the summer.

The results of that experiment are used for the cost estimates shown graphically in Figure 7. In addition, an estimate of the cost of a possible future high-speed photocomposing system was incorporated. Since the computer photocomposition system can be expected to achieve higher readability with more information on the page, the effect of typographic style decisions is shown graphically for two new typographic style information densities: for three old pages on two new pages and for two old pages on one new page.

Any final cost-effectiveness evaluation and decision by management to implement such a large system must be preceded by a consideration of

costs alone, and it is necessary to show the relative variation in composition, printing, and binding costs as a function of the number of copies. This can be done by inspection of the curves in Figure 8 (which were prepared from the curves of Figure 7).

For this application of computer composition techniques, it seems clear that if (1) the cost of original keyboarding is charged to the preparation of master records for information retrieval, and (2) a substantial

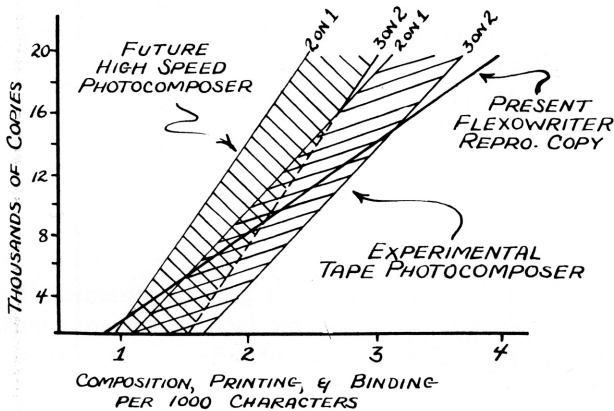


Figure 7. A specific set of comparative composition, printing, and binding cost curves.

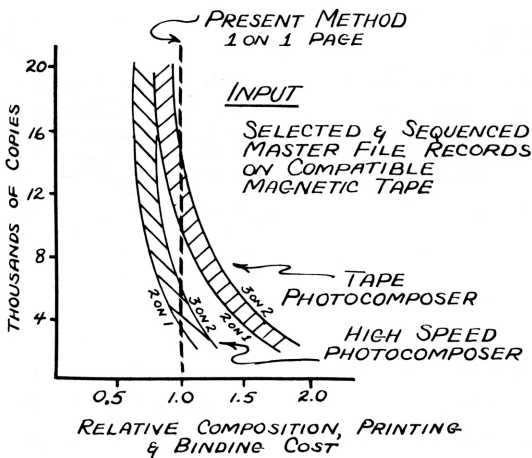


Figure 8. New process composition, printing, and binding costs related to present method costs.

number of printed copies are required, the computer composition system can compete with the present Flexowriter process camera system.

Although this paper has not addressed itself to software problems—i.e. the time and cost of one-time system development and experimentation including computer file maintenance, selection of information for printing, and insertion and typesetting computer programs—it should be obvious that the preceding conclusions on economic feasibility are valid only if a complete and flexible computer-typesetting software system for performing the above functions is properly debugged and made widely available.

If this is efficiently done, then the cost of the operating programs plus the cost of computer running time should be about 20 cents per 1,000 characters, or \$1.00 per page, as shown in Figure 3. Of course, this is based on the assumptions that a modern general-purpose computer will be used and that the one-time system development costs will be recovered over several million photocomposed pages.

In conclusion, it is my hope that this presentation has provided greater visibility and appreciation of the part played by relevant cost elements in existing and future composition and printing systems. It was also intended to direct attention to economic facts which are sometimes lost in controversy over the technical issues of printing automation. It has been my experience that the use of such graphical methods to present the technical cost effectiveness results of a complex system analysis is essential if we are to resolve realistically much of the current cost uncertainty in evaluating important electronic printing applications.

THE AUTHOR

Edward J. Forbes is a consultant in the Information Technology Division of the National Bureau of Standards and was from August 1962 to September 1964 the Electronic Printing Research Officer of the U.S. Government Printing Office.

Chapter 14

DEVELOPMENT OF LEXICAL-GRAPHICAL COMPOSER- PRINTER (LGCP) SYSTEM WITHIN THE AIR FORCE ¹

ROBERT P. MUHLBACH

Chief, Publishing Division

Directorate of Administrative Services

Headquarters, U.S. Air Force

THE PUBLISHING ACTIVITY in the Air Force is "big business." It is the basic means of communicating concepts, policies, and information throughout the Air Force. And I do want to stress the "communications" concept. Sometimes people think that the publications field is confined solely to such specific functions as printing and distribution. We in the Air Force feel this is a misconception, since these activities are interdependent supporting elements in the total publishing process. This process starts with the idea to be communicated, and ends with the final manuscript being read by a stimulated or at least interested user.

The Air Force produces some 18 billion pages of printed matter a year and spends approximately \$51 million for printing. This material is obtained from commercial printers, from the U. S. Government Printing Office (GPO), and from the 39 mission-oriented Air Force printing plants located throughout the world. The very magnitude of our task demands

¹ This article was prepared as part of the official duties of the author and is in the public domain.

that we be aware of advances in modern printing technology, and that we be constantly alert to ways of applying modern equipment and techniques to reduce the total resources committed to the publishing process.

Air Force interest in the Lexical-Graphical Composer-Printer, called the LGCP System, had its beginning with a study conducted for the Rome Air Development Center, Air Force Systems Command, by the Syracuse University Research Institute in 1959–60. The basic impetus for this investigative program was a request from the Assistant Chief of Staff, Intelligence (AFNIN), Headquarters USAF, to investigate and examine graphics-semantic composing techniques then available. More specifically, the study examined the feasibility of designing and developing a highly automated foreign language translation system, which would incorporate the automatic processing of illustrations and graphical data, and at the same time maintain the proper position correlation between text and graphics.

The final report on 1 June 1961 (Syracuse University Research Institute, 1961) concluded that “. . . applicable equipment is available, with relatively minor adjustments in some cases, to build a working system within the short range phase.” In addition, the study found that “. . . present ideas, research, and development indicate the complete feasibility of achieving such a coordinated system complex.”

As a result of these conclusions, the Air Force's Rome Air Development Center (RADC), Griffiss Air Force Base, Rome, N. Y., on 1 January 1962, let a one-year study contract with the Mergenthaler Linotype Company to investigate the design of a Lexical-Graphical Composer-Printer System (Mergenthaler, 1963).

The study was guided by the work statement defined by the RADC, and encompassed the following areas of investigation:

1. Lexical matter and the format problem.
2. Page composition and makeup.
3. Character generation and display.
4. The graphics-handling problem.
5. The output-recording medium.
6. The LGCP system.

During early 1963, AFNIN requirements for further exploitation of the LGCP system were cancelled because of changes in the foreign language translation program. However, the Mergenthaler Linotype Company continued its research because of the great potential for eventual use of such a system by Government agencies and industry.

It was at this point that the Publishing Division, Directorate of Administrative Services (AFDAS) of Headquarters USAF took over responsibility for getting the LGCP program in motion. Maj. A. F. Elmo, Chief of the

Division's Printing Management Section, was the prime mover in evaluating how the system could be applied to AF publication requirements. After several briefings by the sponsoring committee, over a period of several months, he was able to define for the Division which system characteristics would apply to Air Force needs. These were: (1) pre-programmed formats on tape, (2) preprogrammed manuscript on tape, (3) increased type density, (4) enlarged font selection, (5) additional character selection, and (6) automatic text/graphics position correlation.

Various benefits will accrue from this system. We will get typographic density equal to that obtained from conventional hot-metal machines, a large font selection, and as many extra characters as we require. In addition, we will have formats prepared on tapes, and will be able to accept and use manuscript on magnetic tape—all of this at a speed of 600 pages per hour.

Next, we studied and equated the system's characteristics in terms of their effect on Air Force publications which had already been computerized. We found that we could get (1) more information per master copy, (2) fewer master copies per publication, (3) fewer total pages, (4) reduced reaction time, and (5) increased timeliness of information. With the installation of LGCP, we will have the advantage of getting more information on a page than is now possible through computers; thus the resulting publications will require fewer pages.

There followed an evaluation of various types of publications throughout the Air Force concerning their individual requirements as to volume, information density, etc. With this information we were able to identify those publications that would be most applicable to the LGCP system. We first looked to high-volume publications which are fairly standard in appearance throughout and which had a requirement for frequent updating. Prime targets for conversion to LGCP are those publications now being produced by computer printout. Many of these publications—and they make up about 10 percent of the 18 billion pages referred to previously—are currently wasteful in the reproduction process. They have excessive white space, are usually printed out in all capital letters, and are monotonous because of the lack of variation in type. The end result is a wide-open page that is difficult to read. Stock lists, technical orders, and allowance documents are specific categories of Air Force publications that deserve a detailed evaluation.

Having identified the categories of publications with a favorable potential impact on printing savings, the Publishing Division requested the Air Force Logistics Command (AFLC) to evaluate annual production requirements in these publication categories. An example of information density savings can be seen in Figures 1 and 2.

Figure 3 shows projected savings in printing funds alone which we expect to realize once we have LGCP working properly. In the table, "SL's" means stock lists or catalog-type publications. "TO's" are technical orders or manuals, which tell how to use and service Air Force aircraft and missiles. "TA's" are tables of allowances, which show Air Force activities (or personnel) that are authorized to draw AF stocks, tools, clothing, and other items. We anticipate a considerable increase in information density per page, a corresponding decrease in number of pages, and a similar reduction in the over-all printing and binding effort. The LGCP system will make annual estimated savings as follows:

1. Elimination of 126,000 page negatives.
2. Elimination of 607 million printed pages.
3. A saving of \$1,214,000 in printing funds.

The above projections are based primarily on the printing production savings only. Of course, there are several other categories of savings that

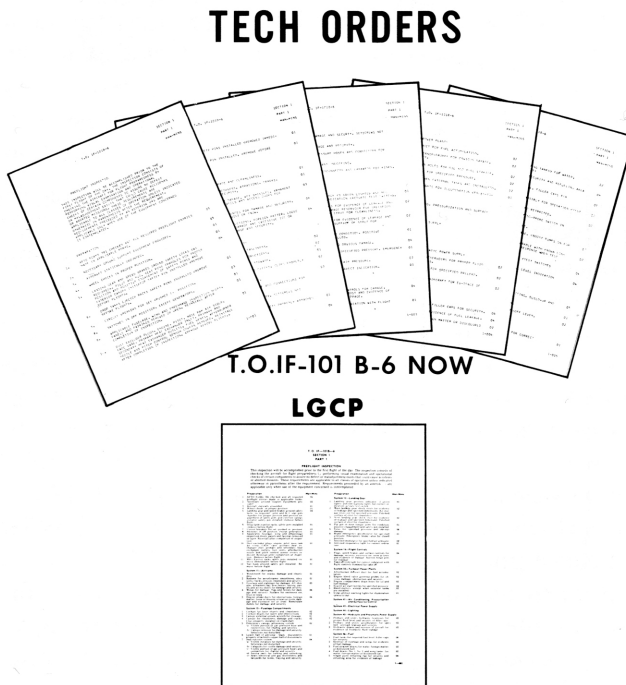


Figure 1. Example of Information Density Savings by LGCP

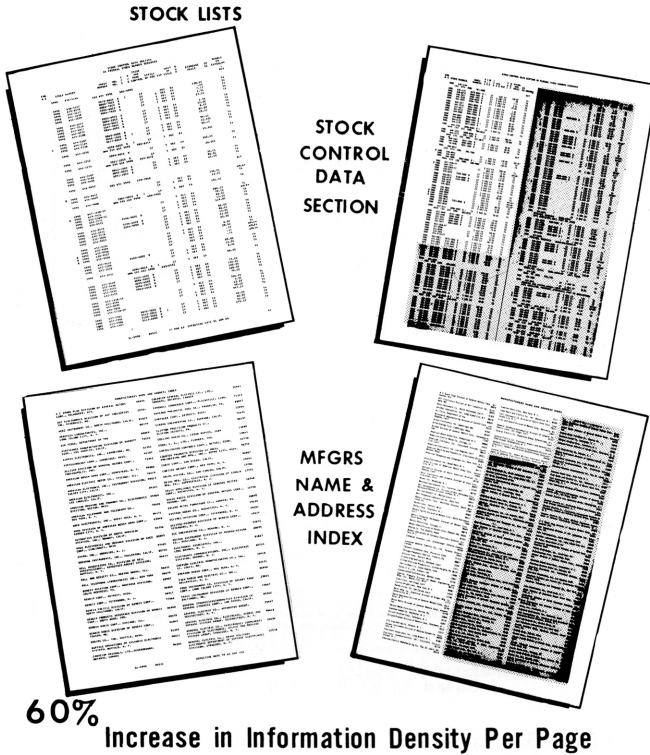


Figure 2. Format Comparison—Computer Printout (left) and LGCP (right).

will result from the elimination of such a high percentage of printed material. For example, the elimination of 607 million pages will produce substantial annual savings on manpower, computer rental, filing space, and transportation.

There is another aspect of the problem—the matter of responsiveness, that is, the ability to reduce the time required for composition and printing. We haven't priced out responsiveness, because it is hard to do. It is very difficult to produce figures with which everyone agrees. An example of responsiveness was the production of a particular stock list which ran 5,900 pages. The page makeup took 14 days, plus 14 days for printing, making a total of 28 days from start to finish. With LGCP we can achieve a 70 percent cut in processing time—specifically, two days for page make-up and six days for printing, or a total of only eight days. Because the system eliminates the requirement for so many page negatives, the total printing time is drastically reduced. While we can't price out this increased responsiveness in dollars alone, it certainly makes sense.

With these projected savings, we estimated that the four-million-dollar

Printing Funds Savings

PUB	INFO DENSITY INCREASE PERCENT	PAGE NEGATIVES (Thousands)		PRODUCED PAGES (Millions)	
		NOW	LGCP	NOW	LGCP
SLs	60	245	98	805	322
TOs	50	36	18	148	74
TAs	50	20	10	100	50
TOTALS		301	126	1,053	446

- Total page negatives eliminated.....126 thousand.
- Total pages eliminated.....607 million.
- Printing funds* saved.....\$1.214 million.

* Based on \$2.00 per M rate.

Figure 3. Anticipated Printing Savings Using LGCP.

LGCP System could be amortized within three years. Figures relative to costs, projected savings, etc., were presented to interested offices of Headquarters USAF, and the LGCP was finally approved. Following this, the Publishing Division requested approval of the Congressional Joint Committee on Printing (CJCP) for eventual acquisition of this system. On March 10, 1964, the CJCP, in a letter to the Secretary of the Air Force, approved our request (see Figure 4).

It should be noted that our LGCP at Wright-Patterson AFB must be compatible with the composing system now on order by the GPO. As is indicated in the letter in Figure 4, the Air Force and GPO must work together in developing not only the hardware but the supporting software as well. We plan to have the Air Force and GPO systems compatible to the extent that both systems will be operative from identical input materials.

By September the funds had been approved, and in November our operational command, the Air Force Logistics Command, completed a contract with Mergenthaler Linotype Division of the Eltra Corporation. Programmed system implementation dates are:

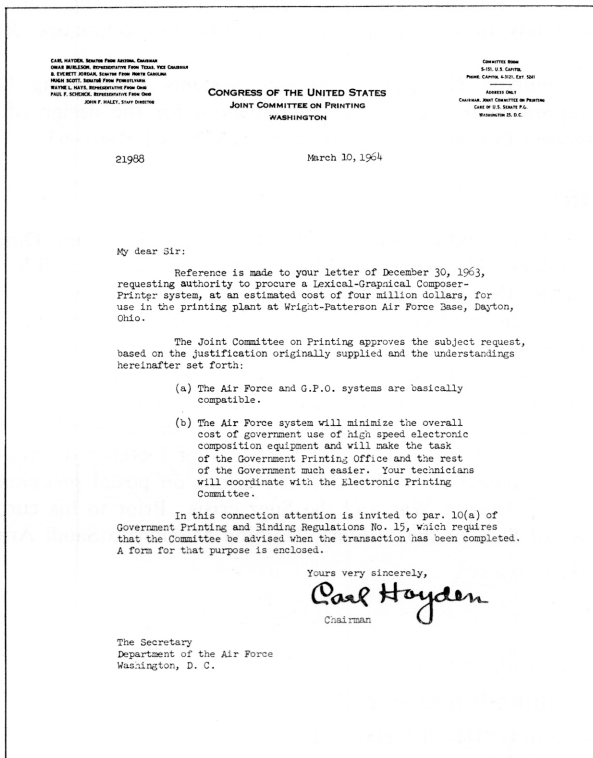


Figure 4. Approval by Congressional Joint Committee on Printing of LGCP for Air Force Procurement

1. Contract awarded—November 1964.
2. Format manual—September 1966.
3. Build format processor—December 1966.
4. System acceptance tests—January 1967.
5. Installation at Wright-Patterson AFB—March 1967.
6. Final acceptance—May 1967.

The current challenge now is one of identifying and converting additional publications to the LGCP. Of our total annual printing production, we estimate that about 20 percent can be converted to LGCP production. At present, we are pursuing studies along these lines, with further savings in mind.

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THE AUTHOR

Colonel Muhlbach is currently Chief of the Publishing Division, Directorate of Administrative Services, Headquarters USAF. He attained his B.S. degree in Military Science at the University of Maryland, entered military service in 1941 and was integrated as a regular officer in June 1946. During the 1950's and early '60's he directed many support service type organizations, concentrating on resource conservation through more effective management techniques. He served as Director of the Armed Forces Courier Service, Director of the Army-Air Force Postal Service, and Chief of the Allotment Division of the Air Force Accounting and Finance Center. He was also Chief Advisor to the Secretary of Defense on military postal matters and principal consultant to the United Nations on postal procedures for the UN Forces during the Korean War and the Suez crisis. Prior to his current assignment, he was Chief of Staff of the Military Training Mission to Saudi Arabia.

Chapter 15

BETWEEN HERE AND SOMEDAY

JOHN W. SEYBOLD
President, ROCAPPI, Inc.

WHAT I WANT TO SAY PRIMARILY is that the future in the application of the computer to the Graphic Arts industry exposes some dimensions, some applications, some exciting opportunities of which we can scarcely be aware at the present time. It is extremely difficult, for example, to talk about technological displacement of labor because of our failure to appreciate the implications of the situation created by the process.

TODAY

We have had in our own company some personal experience over the last several years with the process and with the market, and we have no hesitation about saying that this is one of the most fabulous markets that one can conceive of; that it offers employment opportunities galore; and that we are proceeding ourselves as quickly as possible to set up a nationwide franchise arrangement for the use of our programs in order to cultivate this market, because we know where it exists and we have programs that we believe are applicable at the present time to large segments of it. And yet what we are speaking of is only the barest conception still of what the market has to offer and where it may be.

SOFTWARE—HEART OF PROBLEM

The topic which has been understated is "software." There has been a great deal of attention to economics; there has been a great deal of attention to some of the niceties of the software problems; there has been considerable attention given to hardware here and hardware to come; but there hasn't been, in my judgment, sufficient emphasis upon the software problem.

This is, as I see it, the heart of the problem of where we are and where we are going. And this is what I call the area of human limitations in the topic of "Between Here and Someday." The human limitations pertain also, of course, to the development of the hardware. There are important developments that are required in this respect. But primarily these limitations have to do with the application of the software package or packages. When we first founded our company, we visualized that we could write a hyphenation, justification, and pagination program for an investment of around \$50,000 of time and effort, and that we would have it off the ground in less than a year's time. In fact, our initial target date was about six months after we had mapped out pretty carefully, by interviews and studies, what it was that we contemplated.

We were off the expense involved by such a fantastic proportion that I hate to tell you. And we were off on our time factor by at least 12 months, and I guess this is standard practice. But what we have achieved has been done with incredible dedication, nightmarish effort and hard work—the kind of thing one would never want to go through again, but one would never exchange the opportunity to have had the experience. These were primarily software problems.

Problems Come from Lack of Understanding

They grow out of the lack of understanding by the Graphic Arts technician of the computer potential and the lack of understanding by the computer analyst and systems man of the requirements of the Graphic Arts industry. I suppose these problems exist in every application in the applying of computers to the railroad industry or airplane scheduling or whatever it is. But in this particular instance, it is a wedding of an ancient art with a modern technology. And although it is possible to devise special-purpose programs to do particular things, our aspiration, at least, was to capture all of the flavor of this ancient art and all of the possibilities of this art, and in fact to magnify the opportunities to do things as beautifully, as aesthetically, as practicably, and as economically as heretofore.

In the achievement of these programs, we stumbled upon something I suppose we should have been aware of—that the business of computerized

composition is not a field by itself and that it is impossible to define the limits of the field. In fact, it is even impossible to ascertain whether the primary effort is or should be the setting of type, or whether this is merely a by-product of the application of computer techniques.

For example, the local college came to me and said: "We would like you to put out the alumni directory. We haven't put one out for 10 years—it's time we do it—and maybe a computer would be a good way to do it." As we talked about it, it seemed likely that we could do this, but that it would be ridiculous to do it merely for the sake of setting a directory. It was desirable to have on file not merely the names and addresses of the alumni—which in itself is a complicated problem because it's a co-educational college and the names of some of the alumni have changed—as well as their geographical locations, their academic achievements after college, their children, and their number of marriages whatever it may be. We also want to know how much they contributed to the alumni fund so that the president or vice president could call on them for a contribution when he was in a given area. Many of these things are irrelevant to typesetting a directory, but are natural things to do if you are going to go into the business of preparing such a directory. So in this particular instance the creation of a program, or the application of an existing program, really should take into account the total data-processing requirement and the total potential.

Old Approaches Must Be Reconsidered

The thing that is most challenging to me is that the conventional approaches to information retrieval and storage and indexing need to be reconsidered. The people who have worked in this area have worked in it from the standpoint of storage and then sought to develop techniques to find out what it is that they have stored. And they have techniques for scanning, abstracting, word frequency association and strings of associations, permuted indexes and all kinds of ways of finding out what it is that has been stored. And we have discovered that if we start with the assumption that computer typesetting is going to be here to stay, a different kind of look needs to be taken at the problem. In fact, the information should be keyed at the time it is typeset so that you know precisely what it is that you've got and how you expect to use it, how it can be stored, and retrieved. And we have developed techniques to do this. For one major publisher, for example, we are automatically generating an index as we create the book, and the index is being generated merely as a by-product of the typesetting of the book.

Now the interesting implication here is not solely that this should be done as a by-product of typesetting, but when one bears in mind the probable movement someday to optical character recognition and the incredible speed at which information can be input into the computer, one realizes that the person who runs the computer console and the fellows who run the high-speed photographic composition devices aren't really going to be the least bit concerned about the input. They can't afford to be concerned about input. The thing that plagues us is the problem of generating the input, of perforating it, of proofreading it, and making sure it is accurate.

Responsibility will have to be placed back upon the originator of the manuscript (whether this is the publisher or whether it is the author) who presents for scanning or for inputting into the computer something that is totally conceived and something that is indexable and retrievable before it is input.

It seems to me that this is inevitable and logical, but it is not going to be easily accomplished. There is a problem of communication here and a problem of responsibility. Who is to say what the indexable terms are? How, in general, do we reconcile the conflict between the reference librarian and the computer information storage and retrieval expert?

I have a great deal of faith in the librarians and a great deal of interest in and admiration for their judgments. This is what has been called by Paul Howerton the "intellectual headware" of the industry. This is something that I suppose we are not going to dispense with, and I hope we don't. But the implication is that the techniques which need to be developed in this respect will have to be by extension and by an educational process passed back as far as possible—passed back to the publisher, and passed back so far as possible to the author. That is just absolutely inevitable, because it is not consistent with mass input of data to place these responsibilities upon the data-processing branch of the business enterprise. A tremendous educational job has to be done, a lot of experimentation, and the development of new techniques for the classification of knowledge and information. I am not saying this will ever be done perfectly, but now let me go into the ultimate as I see it.

WE MUST MAXIMIZE COMPUTER'S POTENTIAL

We know that the basic problem with the development of human knowledge has been that we forget more than we know and collectively we fail to communicate what it is we already know. We know that most enterprises which have developed techniques find that although this technique or this system or this bit of knowledge works very well in establishment A,

somehow it never can be put into effect in establishment B. Through the failure to communicate, failure to apply, and disappearance of the vital bit of information that motivates people, much more is lost than is ever activated. And the mystery and magic of the computer is that when it gets into a computer program it isn't lost. This is the first time in human history, really, that human competency can be captured and spread even by wire. And so, the problem here is to maximize this great potential of the computer so that it will apply effectively to the whole field of human knowledge.

In the reference librarian application, when you classify facts, you make a single choice. You say a book, under the Dewey Decimal System, is to have a certain number. You may be able to have a few "see also's" or cross references from here to there. But basically you are saying that something pertains to a given fact or given subject only. Here the magic of the computer is that there can be an unlimited field of references. The field of human knowledge can be classified in an infinite variety of ways, and the information can be stored and accessed.

AND SOMEDAY...

I could visualize a kind of Manhattan District project—I use this term just to indicate the total extent of effort that could be placed into the classification of knowledge. I can visualize a \$4 billion project in which we would take every literate person who was unemployed or over 65 or otherwise available, and assign some of them to read Plato and Aristotle and all the scholars of all history, and make a mammoth effort to code as quickly as possible everything that humanity has ever known so that it can be accessed and used. From that point on, the computer typesetting techniques by and large could keep us up to date more or less automatically. The burden can be eased for future generations once the system has been developed. So it seems to me that what has been opened up here is a tremendous opportunity to use knowledge as a tool in a way different from any way it has ever been used.

I don't know whether typesetting is a product or a by-product but I do know that it reaches beyond the typesetter, it reaches into the editorial office, it reaches into the scholar's office, it reaches into the business office. And as the implications are understood and people begin to get insight into what can be done, incredible vistas are also opened. So a total system encompasses the creation of knowledge, input, storage, updating, formatting, output, revising, reformatting, retrieval, reproduction of the information, and ultimate total classification of all knowledge in a comprehensible system. It is the goal that really stands before us.

It's a long-term goal, obviously. It starts with the development of individual information centers. It will start, I think, with professional societies taking responsibility in the field of their own competence as they output their technical journals, their proceedings, and even their membership directories to be able to respond to the demands of their field of knowledge with adequate indexing and retrieval techniques as they generate the typesetting that their ordinary business requirements impose.

Progress toward the ultimate goal goes on to an interrelationship between the learned societies, and ultimately it would encompass the kind of thing that is now being studied in the use of the library with a computer console and reproduction of the answers by facsimile, or other techniques. It is all part of one vast area of the knowledge industry.

Another interesting aspect of this revolution is its impact on human liberty. It seems to me that the process of the development of liberty is the process of the development of conventions within which freedom can be practiced. It might be said that one man's liberty might be another man's treason, in a way—that what jeopardizes one man is the extension of the application of freedom to another, and to avoid anarchy one needs a frame of reference, one needs a set of conventions, one needs an accepted method of behavior, and if this method isn't generated out of normal human intercourse, it is imposed in some fashion or other.

Well, the interesting thing here is that the computer in its application to the field of human knowledge is and will be imposing many, many conventions, and these are acceptable because they are intricate and difficult to understand. This may result in a kind of tyranny. But in a way it may result in a kind of benevolent despotism on the part of the computer.

So it does seem to me that it is possible through the development of knowledge to create a frame of reference in the behavior of human society that permits a wider area of understanding and deviation of expression of human liberty. This, coupled with the enhanced possibilities of communication, can suggest a most interesting new era. Just as we can simulate results without experiencing them now, so we can project courses of action, live through experiences that aren't in fact realized, eliminate alternatives and come to a consensus much more readily than before.

IT'S NOT A TYPESETTING REVOLUTION, REALLY

I wanted to put in this philosophical note which is rather imperfectly conceived because it seems to me that my basic function is to indicate here that we are not on the threshold of a typesetting revolution, but that we are on the threshold of a revolution which, since it is concerned with human knowledge and communication and human understanding, portends

much more to society than we would conceive of in our lifetime. Just as the total amount of information, the explosion and implosion of this information that was described to us, poses serious questions, it also opens to us some very substantial challenges.

WHO MUST MOVE THE FRONTIERS

Who has the responsibility for pushing forward the frontiers? Not the publisher, by and large. The publisher is no innovator. The publisher is no research creature. I speak from our own experience in this respect of almost total failure in the initial days of the launching of our venture to interest anyone in the publishing industry in the implications of what was going on. They expect the suppliers to come to them with techniques. They expect the suppliers to innovate. They expect the suppliers to make alternative suggestions. And who are the suppliers in the knowledge industry, in the Graphic Arts industry? Small people with limited resources dominated by craft traditions, unable to get the next job out let alone think in terms of the long pull. Not people who can undertake this kind of responsibility.

Government? Yes, government by virtue of its vast amounts of money will play a major role, I think, unfortunately to some extent—perhaps the only major role in the development of this field of knowledge.

Equipment manufacturers? Not very much. By and large I do not think the equipment manufacturers can be looked to to further the field of the development, particularly of software that is the key to this total picture. We are referring here, by and large, to the field of the application of human ingenuity to existing technology. But how does the human mind, how does the human imagination cope with this? How does it apply it? I don't look to the equipment manufacturers to do the job.

WE ALL WILL ADD TO JIGSAW PUZZLE

The fact is that there is no one, probably, who can take the leadership and the responsibility to make any integrated and comprehensive pattern for the exploitation of these techniques in the field of human knowledge, and we are all going to be confronted with a mysterious jigsaw puzzle where we all have little pieces and nobody knows what the picture looks like.

It is complicated also by virtue of the competitive system to the extent that when we stumble upon something we are not always anxious to share it. Certainly in our own company we have this problem. We are always being torn by the ambivalence of wanting to go and show: "Look what

we've done," and being scared to death somebody will see and go and do the same thing.

So how does the jigsaw puzzle get put together? I guess it happens only by the kind of tentative, groping interchange which ultimately will begin to suggest the emergence of patterns. I don't know whether this will happen rapidly. I think it is beginning to accelerate, but there will probably be a proliferation of false starts and tentative efforts and wild moves in all kinds of directions before the system can become comprehensible and unified. The way it will ultimately be unified, I personally believe, will be that we will all learn to speak a new language and think a new discipline.

Most of us don't understand, by and large, that a language is more than a language; it is a frame of reference for culture and a way of thinking and everything else that goes with it. So the language and capability of the computer have got to be understood across the land. One must be able to go into the editorial office and say, "Look, this is what we can do and this is how it works." When this happens, and when one comes to understand and think in this frame of reference, then he can make his contribution. And this contribution will enhance the ultimate development which will enable us to use the full field of human knowledge for the betterment of mankind generally.

I have presented a broad frame of reference. But I think I have not understated it. It is the challenge confronting us and the opportunity we all have.

THE AUTHOR

John W. Seybold is the President of ROCAPPI, Inc., and was formerly Executive Director of the Printing Industries of Philadelphia, Inc., a firm he was associated with since 1946. He is an economist by profession who was educated at Swarthmore College and did his graduate work at the University of Pennsylvania. He was and is a labor arbitrator with an active arbitration practice. Mr. Seybold formerly taught economics at several institutions.

He is author of many articles related to the printing industry.

PART V

CONCLUSION

Chapter 16

TOPICAL COMMENTARY

GEORGE P. BUSH

Emeritus Professor, American University

LOWELL H. HATTERY

*Former Director, Center for Technology
and Administration, American University*

THE PURPOSE of this final chapter is to focus on some of the many aspects of the printing industry related to electronics or automation. In addition to the preceding chapters, other evidence has influenced the editors, including informal discussion between speakers and participants, review of the recent literature as indicated in the Bibliography, participation in other conferences, and informal interviews and discussions with specialists in all facets of the subject. The structure of the commentary is in topical form, arranged alphabetically.

The commentaries are intended as joint frank statements of our own impressions, which may or may not coincide with the viewpoints in the preceding chapters. Following each commentary are references to those items in the Bibliography which have a relationship to the subject, e.g. nos. 62, 151. The relationships may range from slight to extensive and are presented for the reader who seeks clues to further information.

Full information on the literature cited or quoted within this chapter can be found under the References at the end of the chapter.

AUTOMATION

The scare-word for both management and labor is "automation." Automation is the promise of dramatic progress and the threat of disturbance.

Automation generally refers to advanced mechanization as well as the pure form of complete automatic control of processes. Many of the comments in this text referred to automation in the broader sense.

Focus of attention is on the electronic digital computer. The computer is now proved out in newspaper publishing. Its extension into other printing areas is slow but it seems sure.

We believe Arthur Gardner has summarized the situation in automated typesetting and we have asked and received permission from him to reprint his twelve statements on "Trends in Typesetting Technology":

1. Typesetting technology will continue to become increasingly related to and associated with data processing techniques—information storage and retrieval, and business machine technology generally. As did the advent of the Linotype create and enable additional amounts of typesetting to be economically practical, so will the current trends in typesetting automation create new sources of both typesetting and printing business.
2. The use of coded control tapes, electronic computers, and photographic techniques will continue to advance and mature until there is little, if any, typesetting being done which does not encompass at least one and possibly all of these factors.
3. Tape will be perforated without concern for its ultimate processing or end use, the transference of alphanumeric information will be the prime objective. Methods of tape conversion, largely through the use of computers, will enable the same tape to indirectly control any typesetting machine—be it hot-metal, photographic or cold type. Under controlled conditions, optical character recognition techniques may eventually eliminate the second manual keyboarding required to produce input tape.
4. Development in tape merging will enable pre-editing and correcting so that the end product—be it a metal cast or film exposure—will be practically error free. Developments

in the quality and flexibility of computer printouts will enable "proofreading" to be practically accomplished prior to the actual setting of any type.

5. Photographic typesetting will continue to mature. Many present machines will gradually be replaced by a generation of high-speed computer-directed phototypesetters. The influence of photographic typesetting developments on hot metal will continue to be gradual and influenced somewhat by developments in typographic conversion.
6. There will be a definite reduction in the manpower skills required to set type, i.e., produce tape. The extension of tape controls and computer applications will no doubt find all typesetting systems requiring essentially the same key-boarding skills as those now prerequisite to cold (typewriter) composition. The extension of computerized typesetting into page makeup and related format procedures will further influence the skills required of tomorrow's typographic technicians.
7. In addition to eventual reductions in time and costs, advancing typesetting technology will also change the internal operational patterns and the external relations of the composing room or typographic plant. Composing rooms will exhibit an increasing tendency to look like data processing centers—and work with the same quiet efficiency.
8. The further development and refinement of high-speed electronic "printouts" or cathode-ray character generation will ultimately enable the setting of type at speeds of more than a thousand characters per second. The economics of such capabilities will, for many applications, more than compensate for any reductions in quality or control that may or may not result.
9. Regardless of the degree to which typesetting becomes automated, the hot-metal process will be here for a very long time to come. The present investment and know-how in conventional methods will not be quickly dissipated. In few instances have new typesetting techniques been conclusively proven more efficient than hot-metal production. Regardless of the methods, the need for a knowledge of typography will remain immortal.

10. An increasingly apparent tendency for the customer to begin "typesetting" or producing coded tape will gain some momentum in the future. The high cost of electronic typesetting devices will prevent many small firms from making the investment, whereas the customer is often financially capable of the purchase. The increasing ease of producing cold type will provide some incentive to customers inclined to get involved in composition activity. The computer service center concept will grow within the graphic arts industry, and particularly as related to typesetting.
11. In the future, the variance in typesetting techniques and associated costs will demand a clearer distinction between "custom-crafted" and commercial work. The matter of economics will largely determine how much typesetting—and how many typesetters—can evade automation in some form.
12. The introduction and acceptance of radical changes in typesetting methods will be gradual. Since automation creates new jobs as it often destroys old ones, the rate of automation is an important factor. Automation in the typesetting field will come gradually, which should measurably assist the accompanying economic transitions. The nature of the work one now does will significantly determine the rate of influence. Contract squabbles and jurisdictional disputes will exert a restraining influence on the application of automated typesetting methods for the next few years.

Related Bibliography Item Numbers: 3, 16, 22, 23, 56, 70, 103, 125, 138, 192, 204.

BOOKS

In contrast to newspapers, the book segment of the printing industry has tended to stay with traditional methods. There are substantive reasons for this. In the first place there are the traditions of the book publishers and the relationships with their authors and editors. Certain habits have grown up, especially with the prima donnas, which militate against computerized composition. Quite in contrast is the attitude in England, where one publisher in particular explains his new publishing system to the author in the early stages of the manuscript in order that the sub-sequences of both mechanization and authorship (or editorship) can proceed together in a coordinated manner. One might say that this arrangement affects aesthetic quality. Perchance; but it may enhance publishing as a social need.

Another aspect concerns the programming of the computer to carry out certain aspects of formatting. It is one thing to justify the right hand margin and to hyphenate, even though this may be expensive initially. But it is quite another matter to edit, to paginate and repaginate, to head, to footnote, and to change fonts. While these actions are possible, they have not become common practice. As of this writing, there are very few computer-published books. It was our desire to have this present volume so published, but there was a tradeoff of timeliness versus unknown costs.

Efforts are being made to automate book production, but it will probably be on a selective basis. Management, economics, competition, funds for new equipment, experience, all these and other factors such as aesthetics are potent items for consideration. One might well watch the activities at ROCAPPI, Inc., the U. S. Government Printing Office, and the U. S. Air Force at Wright-Patterson Air Force Base, Ohio.

Related Bibliography Item Numbers: 35, 55, 59, 110, 116, 117, 122, 160, 176, 206.

CENTERS

Since the cost of both hardware and software is high, certain entrepreneurs have considered the idea of offering either or both on a service basis. Thus the plant which may wish to try out various aspects of automation without committing capital assets too deeply can farm out portions of the work. Perhaps the most ambitious of such service concepts concerns the Chicago area; the idea is known in brief as Corplan. It envisions a 50-mile radius circle within which by 1980 there will be operating a network of printers and their service associates whose final costs in the area are so low that it would be futile for outsiders to bid.

Another, though less ambitious, project was announced in August 1964 for the New England area out of Boston. Another, in the Detroit area, was announced in September 1964. On the West Coast in the Los Angeles area one notes a literature service offered by Composition Information Services, Inc. In the Philadelphia area, ROCAPPI, Inc., provides services in the field of directories and reference works. The Associated Press was considering in January 1964 a far-reaching program of regional computer centers to produce typesetting tape.

With the rapid changes going on in both hardware and software, these various services reduce the individual risk and substitute a service charge. It would appear that such service costs, including regional transportation costs, should be carefully computed so as to attract business on the one hand and to provide a sufficient kitty to insure the updating of obsolescent

equipment and related software on the other. Alert entrepreneurs might well give this newly opening field their serious attention.

Related Bibliography Item Numbers: 17, 22, 80, 118, 119, 147, 152, 186, 194, 195.

DIRECTORIES

One way to gain experience in book automation is to tackle directories first. The relative simplicity of directory production is attractive, particularly when one has a stabilized product and/or conditioned clients. You learn to work out the "bugs" and become familiar with the newer technologies at the same time. John Markus has demonstrated one way of accomplishing this and has spelled out the steps in considerable detail. Of interest are the by-products, such as mailing lists, billing and accounting data, and future composition ready for updating.

There is in this country a large amount of directory business which is now amenable to automated processes. Those who have pioneered this development have shown by example how other segments of the printing industry could proceed. There is a problem, however. The directory printing business is largely dominated by traditionalists. "We make enough money printing directories the present way. Why put cash into new technologies whose capabilities we are not sure of and take a chance on fouling up the product?"

Related Bibliography Item Numbers: 82, 125, 165, 188, 205.

ECONOMICS

In the case of an emerging or changing technology where the vendors have been expected to take the initiative in pushing changes, it is vital to business success to be aware of the economics of the situation both for the present and the near future. During the Institute, facts and figures were sought out eagerly, especially during question and answer periods. Moreover, the speakers were relatively frank in such matters and many economic facts are to be found in the presentations.

Sharp pencils and an acute sense of tradeoffs are needed in the printing industry, especially when dealing with software. The editors sense a most urgent need for a feasibility study which combines both planning and economics. Two factors highlight such a requirement:

1. Both the equipment and its related software are expensive.
2. Human beings and their jobs are embedded in a craft-oriented industry.

McKinsey & Company made a study for the Printing Industry of America to identify and analyze basic factors behind printing company profitability. Within a group of 50 companies, 25 operated at about 10% profit and the other 25 at below 2%. This is a sufficient incentive for grasping at any vendor's promises for expense saving. Understandably, it shows the urgent need to look behind each device, each system, each proffered software or service, to project the consequences in one's own shop, the economic effects, the human effects. Nevertheless, calculated risks must be taken.

The Report of the Proceedings of the Computer Typesetting Conference, London University, July 1964 (*Bibliography Item No. 59*), was scanned for references to economics, but none were found. The speakers and their questioners were concerned primarily with hardware, software, management, and labor.

The Bibliography contains 16 items bearing upon economics. For each Bibliography Item Number a few words are appended to indicate the tenor of the content: 11—filmsetting economics; 12—evaluating photosetting systems; 13—work standards, performance evaluation: composing room; 24—LINASEC speeds versus economy and quality; 53—reorganizing composition process; 57—economic advantages computer composition; 71—computer costs life obsolescence; 80—costs computer typesetting center; 95—system of evaluation precedes new methods; 110—rearrangements for book operations; 112—relate computer cost to job it is to do; 114—facts and figures on cold type compo; 132—cut copy editing and composition costs; 163—photo compo economics must include manpower costs; 174—computer economics in billing and production scheduling; 194—TTS tape costs.

FACSIMILE

A facsimile system converts a graphic copy into electrical signals which are transmitted by wire or radio to a receiving point, where the signals are converted back into a copy or replica of the original. In the printing area of the Graphic Arts, such a system offers some advantages (such as speed, accuracy, and economy) depending upon the circumstances of terrain, circuitry, timeliness. To this end many efforts have resulted in a variety of approaches by means of electronics, optics, chemistry, mechanisms, radio, coaxial cables, etc. At the present time there are about 30 brand names and trade names for facsimile systems, but few of these have been applied to printing and these few to newspaper printing. There is considerable interest in improvement of the systems and in their application. While the word facsimile denotes "exactly copied or reproduced," it should be borne

in mind that this is an ideal and that many factors tend toward degradation in the copy.

An annual review of the facsimile art is presented by Mr. Warren H. Bliss to the convention of the Institute of Electrical and Electronic Engineers. At the March 1965 meeting in New York City, Mr. Bliss mentioned three printing applications about which we sought further information: Japanese, Swedish, and that of *The Wall Street Journal*.

1. *Japanese*: There has been considerable interest in Japan in facsimile printing primarily because of the ideographic typography. A page of type having once been composed, there are advantages of speed and accuracy in transmitting it by means of a facsimile system. On the other hand, transmission costs are apparently an offset. We asked the Embassy of Japan in Washington for data to present before the May 10th Institute and received a reply from the Nippon Electric Company, Limited, dated April 30, 1965. We quote a few pertinent lines:

FT-73 Newspaper Page Facsimile

In the period of the Tokyo Olympic Games, the transmission was made between Tokyo and Nagoya, which distance is 240 miles.

The transmission is carried out through the coaxial cable of 24 channels of Nippon Telegraph and Telephone Public Corporation (NTT).

After the Olympic Games, a page or two of newspapers per day was transmitted for trial but it was stopped at present by various reasons.

It takes about six hours to send newspapers from the Tokyo office to the Nagoya office by railway mail even in case the super express train is used. Therefore, the facsimile transmission is very much speedier when the FT-73 is used.

FH-82 and FT-69

The ordinary telephone circuit of 300-3400c/s pass band can be used for the FH-82, in addition to coaxial cables, microwave and carrier transmission circuits.

The FH-82 is used for facsimile (mainly for black and white) and receiving record can immediately be obtained inasmuch as the electrolytic recording paper is used at the receiving side.

The FT-69 is used for phototelegraph and fits for transmitting

pictures of delicate shades. Photo print paper is used in receiving record.

Vestigial Sideband Transmission System is adopted in the FT-69.

The feature of the FH-82 transmitter is the surface scanning type and it is not necessary to place the picture on the cylinder.

From the above quotation we presume that the FH-82 and FT-69 are both in operation although this is not stated specifically. A sample portion of the newspaper page (original, negative, and facsimile print) indicates readable typography and some degradation in the cuts. Equipment is manufactured by Westrex Communications Division of Litton Industries in the United States and by Muirhead in England.

2. *Swedish*: In reply to our letter of inquiry the Swedish Newspaper Publishers Association have provided some data dated May 3, 1965. The Pressfax system is in practice at two afternoon papers, namely, *Aftonbladet* and *Expressen*.

The *Aftonbladet* is published in Stockholm and republished by facsimile in both Gottenburg and Malmo, the distances being 500 km and 290 km respectively. One channel coaxial cable and one radio link in each case with all four links at 48 kc. Eight or nine pages are transmitted per day simultaneously to both receiving points. The transmittal time is 11 minutes per page with 400 lines per inch. The costs when utilizing facsimile are about the same as the costs for distribution by air to south and western Sweden, or even slightly more. But the advantage lies in timeliness since the reader gets later news and these pages are merged with local news in the two local editions. In scanning copies of the local editions one can note some degradation in the pages produced by facsimile.

The *Expressen* facsimile edition is printed in Jonkoping in southern Sweden, a distance of 300 km from Stockholm. Coaxial cables are rented at \$100,000 per year. Twenty facsimile pages are transmitted between 7 and 9:15 a.m.

3. *The Wall Street Journal*: The San Francisco edition is sent by facsimile system using a short-wave radio link to Riverside, Cal., which is located about 50 miles east of Los Angeles. Distribution is made to the southern California area. Typesetting and stereotyping costs are eliminated.

Commentary: Facsimile systems for printing are being used by a very few newspapers. Their prime advantages in either case are timeliness and accuracy. There is some saving in labor. Their disadvantages are costliness of both radio and wire links (the latter being preferably coaxial cable) and the vulnerability of both to weather and other occasional interruptions. A limitation is related to the availability of appropriate radio frequencies for the radio links. Improvements were made during 1964 both in the United States and abroad.

Facsimile has many other applications, but not falling within the concept of printing. There is speculation from time to time concerning the linkup of several newspapers by a facsimile net system. This scheme has possibilities, but there are certain economic factors to be considered in the tradeoff: local advertising, local news, local editorials, transmission circuit costs, degradation of readability, and the ever-increasing use of punched and magnetic tapes for computer typesetting.

A final comment concerns an application of fiber optics as reported in *Spectrum* (June 1965) under the title: "Fiber optics produces facsimile transmission." It is stated that: "An entire daily newspaper, for example, could be transmitted to the moon and reproduced from a single 8-by-10-inch film with absolute fidelity and resolution. Such a system could also be used for transmission to ships at sea and flying aircraft." The editors note the words "could be" in the two preceding sentences, but the last paragraph of the article states plainly: "A complete phototransmission system based on fiber-optics circle-to-line converters has already been fabricated and delivered by DuMont."

Related Bibliography Item Numbers: 33, 67, 86, 87, 97, 115, 129, 156, 197.

LABOR

The New York Times for June 24, 1965, carries this headline:

POST WILL RESUME PUBLISHING TODAY. UNION
AGREES TO LET PAPER USE COMPUTER FOR A
WEEK.

Regardless of the merits of either party, it is obvious that differences exist between management and labor in the printing and publishing industry. Arthur Gardner refers to the "perennial problem of labor's 'insatiable economic appetite.'" Outside the printed page one hears the strongest statements accusing printing craft unions of unreasonable opposition

to introduction of improved methods. There is no doubt that a large segment of printing industry management walks in constant fear.

On the other hand, union officers protest such accusations. Mr. Cremonesi of the International Typographical Union states that "the ITU has taken the position, as a matter of policy, of encouraging every form of progress." John J. Long, Legislative Representative of the International Printing Pressmen and Assistants' Union, said in a presentation at the Institute: "Our International Union has never in its history resisted change."

Fear of job loss is at the root of much of the difference. Mr. Cremonesi says, "We make one simple demand—that the printer rooted out of his place in the composing room be given the first opportunity to perform the process displacing him." And it seems apparent that technology will displace employees. Fortunately on this score, the printing industry is in a growth period which seems likely to require all trained printers for the near future.

Employers fear strikes and the economic pressures of higher wages. Demise and consolidation of newspapers are evidence of the economic problems of the newspaper industry. Technological changes are often more expensive in the initiation and transition, and many employers are under such continuous economic pressures that they cannot assume the short-term losses which promise long-term gains. In this respect, continuous union pressures undoubtedly slow the pace of progress.

But the workers themselves need time to adjust to the change. Both the pressmen and typesetters have impressive training and retraining programs to help their members in technological transition and which benefit management in providing a trained cadre. John Long stated that the Pressmen's Union "has a program of education and training for its members unequaled by any other labor union." He added that the Union's "international arbitration agreements with management virtually eliminate industrial strife and work stoppages." The International Typographical Union has established a training center in Colorado Springs, comprising a \$2½ million investment in plant and equipment. The training program includes a class in computer programming and console operation. In addition, union locals also sponsor updating courses.

Changes in printing processes are bringing stresses on union organization. The lithographers and photoengravers have amalgamated. As the craft of printing undergoes continued change and diminution, additional changes in craft union organization are to be expected.

Labor and management agree that change is inevitable, and, in general, that technological progress is desirable. Both are interested in a viable industry. Yet the lessons of working together toward common objectives

seem difficult to learn. A. H. Raskin summarized the recent New York City newspaper contract negotiations in these sentences from his *Saturday Review* article:

The publishers of New York's major newspapers and the 10 unions with which they bargain have just given another impressive object lesson in how not to conduct labor-management relations.

The present contract round is staggering to a close with the publishers bitterly divided and with unions representing three-quarters of their 17,000 workers outside the unity council that once represented the chief hope for newspaper labor stability.

There are of course many instances of labor-management negotiations and relationships which are constructive and mutually beneficial. We must hope for more evidence of management and union statesmanship with a team approach to orderly but rapid-paced progress.

Related Bibliography Item Numbers: 14, 15, 26, 62, 63, 64, 65, 85, 93, 100, 120, 140, 143, 144, 146, 150, 154, 155, 157, 168, 170, 181, 189, 190, 196, 198.

MANAGEMENT

Management, which consists of all of those policies, decisions, and other actions which control the operations and output of an organization, is affected throughout by changes in printing technology.

In this symposium, and in the literature, more management questions are raised than are answered. Experience with typesetting changes and other new processes has not yet proven out the choices among managerial alternatives.

Throughout the chapters in Part II, which report experience, are many hints to management. In fact, hints are found throughout the text and in the literature of the Bibliography.

Perhaps the biggest challenge to management is to overcome resistance to change. The overt resistance credited to unions is often equaled by the unstated reluctance to change on the part of management. It is interesting to note the exhortation of leaders within the industry to their colleagues to be alert and open-minded to innovation. The fact is, however, that the printing industry as a whole is behind most other major U. S. industries in applying the electronic computer to its own operations.

It seems likely that the organizational structure of the printing industry is undergoing change. Larger printing organizations seem inevitable. The

growth of service centers is predicted by some. Internal organizational structure must be adapted to process changes.

Just as for the craftsman, the job of the printing executive will be less craft-oriented and more confined to the generic topics of management: costs and economics, marketing and customer relations, scheduling and control, supervision and labor relations, and the management of innovation.

Within each of these management problem areas are more precise questions and issues. Many of these must be answered for an individual executive and his own organization, on the basis of accrued experience.

The printing industry should study the automation experience of other industries to learn from them and to avoid repeating their errors.

Related Bibliography Item Numbers: 31, 45, 50, 60, 68, 69, 76, 94, 121, 145, 153, 172, 175, 193.

NEWSPAPERS

The newspaper segment of the printing industry happened to be the pioneer in introducing electronics, largely because adaptation was easier and because of economic pressures.

There are three main categories of newspapers: the large daily, the smaller daily, and the weekly, each with its distinctive characteristics and problems. The situation is dynamic with respect to technology, to labor relations, and to corporate relationships. We presume that each of these factors will continue its present dynamism for many months. We use the period of months because the Graphic Arts area is in such flux that the present newspaper as a mass communication medium could change.

Each situation is unique and will be resolved in terms of timeliness of the news, editorial wisdom, support by the advertisers, adaptation of technology into both a printing system and a publishing system. Finally, there is great need for a better understanding between management and labor. We suggest training, education, and teamwork. (See also the topic: Labor.)

Related Bibliography Item Numbers: 7, 17, 23, 42, 51, 52, 54, 58, 61, 74, 91, 96, 125, 139, 155, 157, 166, 170, 173, 177, 181, 203, 210, 211.

OCR (Optical Character Recognition—Scanning, Reading)

Optical character recognition is an optical-electronic-mechanical process by which a reading machine identifies the alphabetic, numeric or symbolic characters in a printed or cursive writing text. It is an attempt to replace a man by a machine in reading source documents. Naturally, this is a diffi-

cult feat. Man can be taught to read a wide variety of fonts of type, having varying degrees of degradation. Likewise, man can read hand-lettering and cursive writing in many scripts up to the point of illegibility. To expect a machine to be programmed to perform these feats is expecting a lot. But there are great rewards for the man who solves this problem, or even chunks of it.

As a case in point, let us turn back to April 19, 1965, about two months prior to this writing. On that date in New York City at the offices of Harris-Intertype Company, Farrington Electronics, Inc., gave a demonstration of its Optical Page Reader type 1P4P. A source document had been prepared on a typewriter, using special symbols which served as instruction codes in the system. Punched six-channel paper tape was produced and this was passed through the scanner (reader) and then by electronic signals transmitted to the computer. There the program instructions of the computer performed various formatting functions and the product was reperfected on punched tape, justified, hyphenated, columnarized, and otherwise composed. This tape was fed into the desired typesetting machine, in this case a Monarch linecasting machine, but a Fotronic or Photomatic photographic film typesetter will also receive it. As to speed, the typed pages were read at five lines per second, which limits the whole process.

Recognition Equipment, Inc., has announced the Electronic Retina Character Reader, which is "capable of recognizing six or more type fonts intermixed with numerals, upper and lower case alphabetical characters, and special symbols in each, reading at a rate of 2400 characters per second." Presumably, this is equivalent to 15 pages per minute when 36 lines are read from each page. The machine system includes a Programmed Controller having 8000 characters of core storage for editing and formatting purposes.

The preceding paragraphs are in marked contrast to the ideal reader as visualized in the opening paragraph. Two principal questions arise: Why is such a reader of importance to the printing industry? What is holding up progress? The reader is important because the computer is of ever-increasing importance in typesetting and computers have both input and output problems—they are snail paced compared to millisecond-electronic pace. The output (printout) is gradually picking up speed but has a serious drawback in the matter of fonts of type. Similarly, the input (the reader) has difficulty with fonts of type. The case mentioned in the preceding paragraph concerned one type font only—a typewriter.

And here we come to the nub of the problem: sophistication versus cost. Comment by knowledgeable persons at the Institute of May 10th

appeared to agree on a statement to the effect that: The state of the art is such that a manufacturer can produce an optical reader which could read fonts (plural) and legible hand-lettering provided funds were made available for development and cross-licensing of patents. Furthermore, the amounts of money should be comparable to the funds spent for computers themselves, namely, several thousands of dollars. Each increment of sophistication would require added funds. Thus far, the Federal Government has not seen fit to underwrite this type of funding and the individual developer has not seen fit to take such large risks.

The editors believe that pressures within the printing industry and other industries will be so strong that the sophistication-funding problems must and will be solved either here or abroad by 1970, *but* other technologies such as microphotography and microthermography are making conspicuous progress.

Related Bibliography Item Numbers: 6, 8, 9, 10, 47, 108, 142, 148, 164.

PHOTOTYPESETTERS

During the discussion period on "High Speed Photo Composing Systems" at the Computer Typesetting Conference, London University, July 1964, Mr. A. B. Tyrell of the British Ministry of Labour commented in part (Institute of Printing, 1965, p. 234):

This procedure of waiting for techniques which may be an improvement on ones currently being developed is a very dangerous one. This has been shown to be true in some of our old print industries. While you are waiting for something which may or may not materialize, you tend to fall behind, and the productivity of other countries which are adopting new techniques tends to rise vis-à-vis your own. You then find yourself in an embarrassing position trying to catch up. . . .

Having in mind the foregoing, it is of interest to read the chapter by Charles J. Austin on the MEDLARS system and its subsystem GRACE. This subsystem in being uses the Photon 900 computer phototypesetter. The chapter by Victor Corrado is also pertinent. It presents the development of a photocompositor by Mergenthaler Linotype-CBS Laboratories, which is scheduled for delivery in 1966.

Phototypesetters appeal to printers for various reasons, including reduced costs, lighter-weight machinery, more easily trained labor, greater versatility, and more creative formatting. Also, the composition is lighter

when stored for future use. Each such advantage must be weighed against the realities of the printing plant situation.

This is not the place to comment on the many competing types of phototypesetters, but attention is drawn to a recent article by Selah Bond (1965), which deals with late developments in this area. This author states, "Regardless of the various points of view, electronics have now become a part of the printing industry."

Speaking of printing industry traditions, the article concludes with these words: "The revolution in printing must be spearheaded by a generation with youthful ideas. New equipment must be examined. New methods must be explored."

Related Bibliography Item Numbers: 4, 5, 18, 19, 20, 21, 27, 29, 30, 36, 38, 40, 41, 44, 49, 66, 75, 78, 79, 81, 90, 107, 109, 111, 113, 114, 119, 123, 128, 135, 141, 143, 147, 168, 188, 202.

RESEARCH AND DEVELOPMENT

A recent report of the National Science Foundation, NSF 64-25, states:

The following relationships were positive, strong, and significant for all companies and for large performer companies: (a) Net sales and company R&D funds. . . . [p. 21]

Turning to NSF 64-9, which was related to the period 1961, one notes (p. 40) that paper and allied products had a ratio of .7%. The printing industry is not included in that analysis, except under the general term "Other Manufacturing Industries," but during the Institute a figure for this ratio was mentioned as being a fraction of .1%. Bearing this approximation in mind for a moment, one hears the comment that there seem to be many new faces at this or that meeting of printing industry people. One explanation offered was that these shining new faces were worn by non-printers who were categorized as research types, programmer types, development types, reprography types, communications types, etc.

Of course research and development goes on here and there in the commercial printing business, but there is much more development related to printing in other of the communications arts. On the face of it, this looks like lethargy in traditional printing contrasted with external interest. It is also intriguing to note mergers and pre-mergers where weddings are arranged between the traditionalists and the "far-outs." After all, this is one way to do research—buy it with stock.

There is bemoaning to the effect that the Federal Government has not made substantial research and development funds available to the printing

segment of the economy. Although this is true, we note that funds are expended by the Air Force, the Army, the Navy, the Census Bureau, the Bureau of Standards, the Government Printing Office, the Library of Congress, the National Library of Medicine, the National Aeronautics and Space Administration, as well as other substantial allocations to certain specialties like maps and weather maps. Taking a wide-angle look at this and the fringe-benefit vendors, we see that there is a considerable amount of R&D fallout available right now for a great quickening of the printing industry. One comment which has come to the editors concerning the American University Institute was, "The interesting part about the Conference was that everybody was talking about 'far out' things they are *doing* right now. A totally different attitude."

Relate this comment to the one by Selah Bond, under the topic of Phototypesetters, and one senses the quickening of the ongoing revolution in the industry. We do believe, however, that research in the managerial aspects of new printing technology and methods is almost totally missing but is critically needed.

Related Bibliography Item Numbers: 1, 34, 39, 72, 73, 83, 84, 92, 105, 106, 127, 131, 134, 149, 161, 162, 171, 180, 183, 184, 207.

TELEPRINTERS

The subject of teleprinters did not find a place on the Institute program, because the program was already crowded. It may not be of much interest to printers, but we venture the thought that lately, since the advent of electronic applications, this field has assumed added stature in the over-all communications field. We point to a sentence in Mr. Seybold's chapter (15) regarding proprietary secrecy: "We are always being torn by the ambivalence of wanting to go and show: 'Look what we've done,' and being scared to death somebody will see and go and do the same thing." The ambivalence applies to teleprinter development at this time. It is like an iceberg with only a fraction above the surface.

With respect to Item 136 in the Bibliography, by W. Y. Lang, Mr. Lang has advised us that his paper had a submission date to the IEEE which caused omission of material "three to five months behind the up-to-date trend." At that, W. A. Kaiser's electronic system, which is operable over either wire or radio links, is a very great advance. (It operates at 225 characters per second.) Also, Roman Lutz (1965) has developed an electronic telegraph synchronizer, which enables the message to bridge periods of fading affecting more than 100 telegraph signals without loss of phase.

A development in Japan concerns the Mainichi newspapers based in

Tokyo with remote offices in Nagoya, Osaka, and Kyushu, to which ideographic characters are transmitted by teletype.

In our view teleprinter developments bear watching for two principal reasons:

1. Considerable development is in progress, both overt and covert.
2. In the over-all communications field, teleprinters can assume an increasing importance in the linkage between centers of information as these grow and proliferate with our ever-enlarging need for fast and accurate interchange of knowledge.

Related Bibliography Item Numbers: 99, 126, 136.

TYPOGRAPHY

We are conditioned aesthetically to prefer a vertical right-hand margin in a column of type. This process increases costs and reduces the speed of composition. As the need to communicate at greater tempos continues, there are those who advocate a relaxation of aesthetics in some areas. We are not talking about belles-lettres, even though the literate might prefer fewer frills than to go without the document. But many printed communications are needed quickly and cheaply that non-printers can condition themselves to read in a relatively few hours. Thereafter, they scarcely notice the ragged right-hand margin. Uneoprint (Unique New Print Service For Science and Technology) is a case in point. At Unwin Bros., Ltd., all text is set in standard text face on electric keyboard, normally one size for one job, unjustified. Borrow one of these products at the public library, read a chapter, whether you understand it or not. It is less of an adjustment than reading poetry. Roy Burnham's article (*Bibliography Item Number 42*) contains the statement that ". . . justification is just a fad."

We are also conditioned to hyphenation. The new generation is not as deeply committed as past generations. Nevertheless, we go through the motions. It is difficult to hyphenate in English because it is more a matter of memory than of rule or reason. Such simple differentiations as re-cord' and rec'ord are difficult to teach to a mechanism. We venture to say that many graduate students working on their theses consider it a damnable chore to hyphenate properly.

So we are back to the previous thought: As the need to communicate at greater tempos continues, there are those who advocate a relaxation of aesthetics in syllabification and hence in hyphenation. Justification is costly

and hyphenation is much more costly. One effort involved committing the defined words of a dictionary to magnetic memory. But this is not all, for we still have the discrimination problem of record vs. record, also thought, drought, brought, sought, and others which cost in terms of program time.

Another aspect of legibility concerns the type itself. Psychologists have investigated reading speeds and legibility. There are cause and effect relationships according to Jack S. Scissors of Northwestern University. But here again one can be conditioned to read difficult typography. Back of all this is the fundamental intellectual skill: reading, itself. The complexities of this problem are brought out in a recent issue of *Science*, in "Learning to Read," by Eleanor J. Gibson (1965).

A special case in typography concerns ideography, because it is important to millions of persons. Moreover, cultural values are involved, also political and ideological values to which the Western world gives little heed. An assumption to ponder is: Survival and good communications are linked.

Another special case concerns chemical symbology and mathematical symbology. In the chemical area much has been accomplished by Feldman and his associates in the last few years.

Related Bibliography Item Numbers: 15, 32, 43, 46, 88, 89, 98, 137, 169, 199, 201. Two references not listed in the Bibliography are: Schmidt, Klaus F., 1965, "Notable Changes Occurring Today in Ad Typography," *Printing News*, April 10, 1965; also, Seybold, John W., 1964, "In Computer Typesetting: What Price Hyphenation?" in *Book Industry Mag.* 1:37-38, Sept. 1964.

IN CONCLUSION

In conclusion, as we see opportunities for advance in printing and publishing, we believe an almost superhuman requirement exists for an open mind, courage to experiment, willingness to persist with new methods, and ability to see the process as an integrated system.

We believe that all who are related to the industry must be alert to still more radical change in technology, which will have equally severe effects unless the prospects are seen clearly in advance and preparations are made for changes before they plunge down upon us.

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THE AUTHORS

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Dr. Hattery's experience is described at the end of Chapter 1.

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NOTES ON THE BIBLIOGRAPHY

The Bibliography is included to provide additional background and guidance. By the nature of the symposium, the authors were not expected to document their papers with annotations. For those readers who have the curiosity or need to dig deeper, an endeavor has been made to search for optimum information sources, then include references to them in the Bibliography. The reference is followed in most cases by a brief commentary. When the commentary is by someone other than the editors, that speaker has been noted in parentheses (e.g. Author).

All of the documents cited are dated after January 1, 1963, because the book deals with a dynamic problem. The form of the references follows in general the *Style Manual for Biological Journals*, 2d ed. 1964. AIBS. Washington, D.C. It varies in certain respects to facilitate use in information handling systems. The numbers preceding each entry serve to identify the entry and are used principally in the concluding chapter as supplementary codes following the topical commentaries. This device enables the reader who is interested in a particular topic to be guided quickly to most of the recent literature of the field.

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74. Dunlap, Sky. 1963. Reporter-Computer System 'Feasible' for Many Dailies. *Editor & Publ.* p. 9-10, 52. Jan. 5, 1963. Developments at the *Los Angeles Times* using RCA-301, IBM perforator & Elektron typesetting machines. *Times* reporters showed corrections were needed on only 15 percent of the lines in typed copy.
75. DuPont Develops New Photographic Process. 1963. *Chem. & Eng. News*: Nov. 16, 1964. p. 41, 43, 44. Photo-solubilization leads to positive image rather than negative image as in conventional photography. Expose-fix-develop offers new commercial possibilities.
76. Dyer, Philip F. 1963. Data Processing for Printers. *British Printer* 76: 65-70. Dec. 1963. How printers can use data processing in the accounting and management operations.
77. Electronics Challenges the Printing Processes. 1963. *Printing Mag./Natl. Lith.* 87: 66-67, 94. Oct. 1963. Present day systems of composition are about to be drastically altered by electronic means. A brief discussion of some new technologies.
78. Electronic Filmsetting and Computer Typesetting. 1964. *Litho-Printer* 7: 19-20. Jan. 1964. About the RCA high-speed text-composing system based on optical and television techniques. 500 characters per second, about 900 newspaper column lines per minute, and an 'alphabet' of 100 to 500 characters can be handled simultaneously. Utilizes RCA-301 computer. The computer mentioned is IBM 1620 with IBM 1311 disc storage with data on performance.
79. Electronic Generation of Graphic Images. 1964. A brochure by Navy Publications and Printing Service, Bureau of Supplies and Accounts, U.S. Dept. of the Navy. Apr. 9, 1964. 8 p. A very brief explanation with three printed examples of a production program involving keypunch, computer, converter, photo composition, and offset production. Today both the converter and Linofilm Photocomposer are installed in the Government Printing Office and available for programs by all U.S. Government agencies.
80. Electronics and Its Application in Modern Typesetting. 1964. *Export Polygraph Internat.* No. 50. 1964. p. 5-8. A frank discussion of costs and maintenance problems. "Computers for the Graphic Arts industry—installed centrally and well-organized in their entire operation corresponding to the

- relative requirements—seem to incorporate a quite possible development of the next decade.” (Author)
81. Electronic Tape Reader and Operating Unit for TTS Linecasting Machines. 1964. Res. Inst. Bull. 809: 37–44. Mar. 24, 1964. Features of Star Parts, Inc., Autoserter which operates from standard six-unit tape. Translates tape signals into machine. Functions at high speeds.
 82. Electronic Typesetting Speed Combines with Colour Web Offset at Chapel River Press. 1963. Litho-Printer 6. 251–254. Apr. 1963. Utilizes Linotype Elektron with Fairchild Color King to produce Kelly’s Directories. One is a 2,000-page directory. They prefer linecasting to filmsetters for straight-forward text.
 83. Electrostatic Line Printer Developed at Hitachi. 1965. Japan Electric Industry. Mar. 1965. p. 31, 32. Claimed to be 10 times as fast as mechanical line printer. Quote: “This system for open market has first been made by Hitachi in the world, observers say.” The Hitachi, Ltd., hopes to sell 10 printers in 1965. 128 letters per line; 64 or 128 kinds of type; 6000 lines per minute; paper: roll 500 meters, 460 mm. wide.
 84. Electrostatic Printing. 1963. Graphic Arts Progress 10: 1–2. Nov.-Dec. 1963. A brief review of several processes. Includes a chart which differentiates xerography, xeroradiography, xeroprinting and electrographic recording. Also includes a 25-item bibliography, the latest dated item being January 1963.
 85. Engravers, ALA Delegates Vote Constitution for New Union. 1964. AFL-CIO News. June 6, 1964: 3. First merger of Graphic Arts unions in nearly 50 years was unanimously approved by delegates representing Lithographers and Photoengravers International Union.
 86. Facsimile Equipment Instead of News Boys. 1965. Japan Electric Industry. Mar. 1965. p. 33. This article discusses speculation on sending the newspaper direct to the subscriber’s home. There are still many knotty problems involved. Rental cost of subscriber receiver is estimated at over \$27 per month, whereas the daily newspaper is \$1.50. Japanese homes are small, while facsimile printers are large and bulky. Public acceptance? Broadcasters want to enter the newspaper business as competitors.
 87. Facsimile Newspapers in Sweden. 1964. Print in Britain 12: 30–32. Sept. 1964. An account of the publication, on April 20, 1964, of *Aftonbladet* in Gottenburg by facsimile from Stockholm, a distance of 300 miles. A third edition is published in Malmo. Used is a Press Fax system developed by Dr. Hell, of Kiel, and the American Adler-Westress group. Swedish postal authorities provided 24 news channels: 12 of these via coaxial cable and 12 via radio, thus insuring against faults. It is hoped to increase the band width and channels to effect higher transmission speed, so that channels are in use for a much shorter period. Transmission time is two pages every seven minutes. Malmo and Gottenburg get identical pages.
 88. Feldman, Alfred. 1964. A Proposed Improvement in the Printing of Chemical Structures, Which Results in Their Complete Computer Codes. Am. Doc. 15: 205–209. This method will produce, as an automatic by-product, coded tapes of printed chemical structures, which may be used for chemical information retrieval by computer.
 89. Feldman, Alfred; Holland, Donald B.; Jacobus, David P. 1963. J. Chem. Doc. 3: 187–188. Oct. 1963. A tape generated as structures are typed on

modified keyboards, thus uniquely describing each structure in an encoded form suitable for computer input. Complex computer techniques are required but available.

90. Filmsetting and Cold Type Methods. 1964. Print in Britain 12: 16-page supplement. Nov. 1964. A checklist of machines, materials and methods, specifically: Alphatype, ATF, Fotomatic, Fotosetter, Fototronic, Linofilm, Linofilm Quick, Linotron, Lumitype, Lumitype 513, Monophoto, Megatype, P & M Filmsetter, Photon-Lumizip, Photon Textmaster 713, and Sapton; also a number of film lettering and display machines; typewriter composition machines; list production machines; and conversion systems.
91. First Fully Automated Computer-Directed Typesetting System. 1964. Inland Printer/Am. Lith. 152: 63. Also in Graphic Arts Mo.: 40-43. Feb. 1964. At *South Bend Tribune*. IBM 1620 and IBM 1906 Mod. 2 buffer control. Justified and hyphenated. Intertype Monarch linecasting machine.
92. A Firsthand Report on the Electrostatic Printing Press [at Fort Belvoir]. 1963. Lith. J. 48: 22-27. May 1963. A specially prepared zinc oxide coated paper, fed from a 30-inch web, is first given a blanket static charge. When exposed to light, a transparency leaves an electrostatic image on that part of the paper which light has not reached. The developing process consists of bringing the paper into contact with a suspension of charged particles in a nonpolar liquid. The electrostatic image becomes neutralized by the adhesion of these pigment particles to the image areas, which then appear as printed and developed copy. Five color. Applicable to map reproduction.
93. Fitzpatrick, Joseph H., Jr. 1963. Technology and Industry Directions. Natl. Lith. 70: 24-25 ff. May 1963. "The craftsmen do not consider their work as a craft."
94. Flint, C. S. 1964. Five Predictions for the Future in Graphic Arts. Modern Lith. 32: 31-34, 110. Oct. 1964. Many changes are taking place in the printing industry and the questions are raised: (1) to what extent is the graphic arts industry willing and able to absorb this technical progress, (2) what are the practical limitations in new developments for the graphic arts, and (3) what are the trends that the printer must watch for in the immediate future?
95. Flint, C. S. 1964. Keeping Up with New Printing Developments. Printing Mag./Natl. Lith. 88: 102-106. Sept. 1964. Improved methods and equipment are drastically altering production speeds. Yet is it practical to drop current methods and adopt new ones? A new system of evaluation is urgently needed. (Author)
96. Florida Paper to Add New Automation Link to Computer Typesetting System. 1964. News from NCR, Aug. 20, 1964. National Cash Register Co. NCR 315. Controller linked to 15 teletype readers and 15 teletype perforators and 15 teletype punches and 15 teletype linecasting machines. Publisher Martin Anderson, *Orlando Sentinel-Star*, says much faster than manual.
97. Flynn, George W. 1963. New Way to Print a Daily. Printing Production 93: 42-44, 81. Jan. 1963. *Wall Street Journal* pioneers facsimile printing in which page images are sent by signals from one plant to another; typesetting and stereotyping eliminated in producing this daily newspaper. The facsimile operation is from San Francisco to Riverside, Cal., using microwave transmission. Some details of operation are given.

98. Fullick, R. F. 1964. Setting Type with Computers. *Discovery* 25: 22-25. Dec. 1964. Time and money can be saved by taking the decisions of "hyphenation" and "justification" from the traditional compositor and placing them within a computer. Techniques still evolving permit whole pages of newspapers to be set out automatically. (Author)
99. Furukawa, Hisashi. 1963. The Chinese Character Teletype and Graphic Industry. *Asian Printer* 6, 2: 57-65. 1963. A commentary on newspaper remote-control system between the head office of *Mainichi* in Tokyo and the remote offices at Nagoya, Osaka, and Kyushu. Also the labor shortage in the Graphic Arts, which may be severe by 1966.
100. Gandelman, David. 1964. 7 Answers to Technical Explosion. *Printing Mag./Natl. Lith.* 88: 83. Aug. 1964. "New programs are needed to enable lithographers to meet challenges presented by rapidly changing production and management methods." Premium on self-training and improvement. Management training seminars. 4000 members.
101. Gardner, Arthur E. 1964. The Age of Computerized Typesetting . . . Phase 2. *Printing Production* 95: 48-53. Oct. 1964. The inescapable impact of computers for typesetting functions has descended upon the industry with the greatest force yet experienced. A three-part feature complete in this issue on past, present, and future of this development.
102. Gardner, Arthur E. 1963. Computers and Typesetting. *Am. Pressman* 73: 6, 8-10. Apr. 1963. This brief report discussed what computers are, what they can and cannot do, and, finally, the present and potential applications to typesetting. Also discussed is the effect of computers on the typesetting industry.
103. Gardner, Arthur E. 1963. Electronic Editors & Robot Reporters? *Editor & Publisher*, p. 12, 40. June 8, 1963. General observations on the relationship of automation to newspaper publishing make-up and editing chores, editorial techniques in need of change. The reporter may one day talk his story into a voice writing machine.
104. Gardner, Arthur E. 1963. Trends in Typesetting Technology. *Printing Production* 93: 49. Apr. 1963. A list of 12 trends as presented before Washington, D.C., Craftsmen's Club in early 1963. All of these trends appear reflected in the purview of the American University Institute on Electronics and Automation in Printing, May 10-13, 1965.
105. Getting Along with—and without—Computerized Typesetting. 1965. *Reproduction Methods* 5: 42-43. Feb. 1965. A brief review of computer application, indicating what has been accomplished and what is in the near future. Words of both optimism and caution.
106. Getting Started in Computer Composition. 1964. *Book Production Mag.* 80: 52-54, Sept. 1964. Principally concerned with the ROCAPPI, Inc., experience, with comments on personnel, equipment, and methods.
107. Graphic Arts Composing Equipment: Medical Literature Analysis and Retrieval System. 1964. Bethesda, Md., National Library of Medicine. 2 p. This is a fact sheet relating to MEDLARS and within that system to GRACE (Graphic Arts Composing Equipment). GRACE prints 18,000 characters per minute: three fonts of type 6-, 10-, and 14-point, both upper and lower case.
108. Gray, Stephen B. 1963. A Highly Flexible, Many Font, General-Purpose Page Reader. In *Automation & Scientific Commun.* (See *Am. Doc.* 7/64-151.)

- In development, reads 30 typefaces from six to 36 points at speeds above 1000 characters per second on pages of complex format such as those found in technical books and journals. (Author)
109. Grove, John F. 1964. Producing Quality Composition through Phototypesetting. *Printing Mag./Natl. Lith.* 88: 50-52. Apr. 1964. New techniques in setting type on film enable phototypesetting plant in York, Pa., to enjoy a 30% sales growth each year. Production procedures and work flow are the keys to quality. (Author)
 110. Hagan, William C. 1964. Kingsport and Computers: A Book Manufacturer's Experience in Composition Research. *Book Production Mag.* 79: 45-46. Feb. 1964. (Reprinted in a special report: Computers: Their Impact on Book Composition. Repaginated, 12-13.) ". . . the only way to achieve any appreciable reduction in costs [in book printing] would be through the elimination and/or rearrangement of several of the many operations." Kingsport's experimentation has been encouraging.
 111. Halpern, B. R. 1964. DuPont's Conapress System: Direct Conversion to Film Eliminates Camera, Make Ready. *Book Production Mag.* 79: 52-53. Feb. 1964. Non-photographic film receives image by direct impression, reproduces relief surfaces, halftone dots for offset platemaking.
 112. Hanson, Ellis P. 1965. The Case for LINASEC—operator-monitored computer setting. *Print in Britain* 12: 36-37. A printer simply cannot afford to use a computer for typesetting that is more sophisticated than necessary to fulfill his requirements, and a very close eye must be kept on this relationship between the size (cost) of a computer and the economic value of the job it is supposed to do if future computer installations for typesetting are to prove successful. (Author)
 113. Harrison, J. T. 1964. Problems Involved in the Graphic Reproduction of Mixed Scripts. *J. Doc.* 20: 76-86. June 1964. Photocomposing machines facilitate this usually difficult problem, which entails different sized fonts, directions, and hand adjustments. The author discusses the advantages and disadvantages.
 114. Herrick, Carlton. 1964. Cold Comp: Survey of Processes, Uses, Equipment. *Book Prod. Mag.* 79: 54-59. Mar. 1964. Facts and figures on the economics of using cold-type composition. The advantages and disadvantages in certain applications. "So, we in Graphic Arts will continue to be faced with the necessity of keeping ourselves constantly abreast of the latest technological advances that pertain to our industry. And because molten metal is too unwieldy to be used with this high-speed development, some form of cold type—carbon-set, photographic, magnetic, reconstituted electronic structure, variable energy fields, or whatever—will be used." (Author)
 115. Holland, M. G. 1965. Wall Street Journal Prints Pacific Coast Edition in Facsimile Plant. *Reproduction Methods*. p. 14, 31. Apr. 1965. The printing of regional editions and particularly the radio link from San Francisco to Riverside and the facsimile production there for the Southern California subscribers.
 116. Holliday, Alan S. 1964. Computer Controlled Composition for Books. Part 1: Concepts, Systems, Machines, Manning, Problems, and Solutions; Part 2: Applying the RCA 301 Computer to Book Typesetting. *Book Industry* 1: 22-25, Feb. 1964, and 28-31, 78, Mar. 1964. The first article deals mainly

- with the adaptation of the IBM 1620 machine to the task of typesetting control, while the second deals more specifically with book production. A look at costs is taken in both articles. The various steps are briefly explained.
117. Holliday, Alan S. 1964. When Is New Technology a Good Investment? *Book Production Mag.* 79: 64-66. Jan. 1964. This article describes what is involved in a new technology application study, and how one book manufacturer, Science Press, Inc., Ephrata, Pa., is successfully using the technique to determine what future exists for computers in its operations. (Author)
 118. How Automation and Technology Will Change Chicago's Printing Industry. 1964. *Inland Printer* 153: 63. Sept. 1964. A major study by Corplan Associates indicates what is happening now in six key industrial areas and what is likely to happen in the near future. Corplan Associates is an affiliate of the Illinois Institute of Technology.
 119. Humphrey, James R.; Keaty, Larry. 1964. Pioneering a Photocomposition Business. *Printing Production* 94: 56-57, 90-91. Sept. 1964. Conventional trade composition, computerization of type, and newspaper composition have evolved as three market areas developed by a Detroit area firm in its inauguration of a new photocomposition system.
 120. The Impact on Lithography of Web Offset. 1965. *Graphic Arts Unionist* 2: 31-40. Jan. 1965. Union-sponsored study documents that a technological revolution is taking place in the Graphic Arts and draws some far-reaching conclusions for now and the future. 32 illustrations.
 121. Internal Typesetting Integrity Maintained with Imaginative Use of Repro Tools. 1964. *Reproductions Rev.* 14: 38, 40, 41. Nov. 1964. Time-Life Book Division maintained internal typesetting integrity by a unique combination of reproduction equipment. Six illustrations.
 122. Intertype Corp. Develops Computer for Printing Industry. *Typesetting in Newspaper, Book, Magazine, and Commercial Printing Industries.* 1964. *Typographical J.* 144: 140. Apr. 1964. A brief account of the announcement by Harris-Intertype Corp. of their Editape computer with transistorized unit designed for composing rooms. An illustration shows this machine alongside a Monarch typesetting machine at the ITU Training Center in Colorado Springs.
 123. Intertype Develops Tape Operated Photocomposition Machine [Fotomatic]. *Printing Production* 93: 65, 76. Apr. 1963. An announcement of a single magazine, tape-operated photocomposition machine permitting direct photography of wire service copy in justified reproduction form, as shown at Northwest Newspaper Mechanical Conference, March 1963. Details of operation are stated.
 124. An Introduction to Computer Typesetting. Part 1: Basic Computer Principles; Part 2: The Automation of Typesetting in Application. *Print in Britain* 11: 20-22, Jan. 1964, and 11: 27-32, Feb. 1964. The first installment deals with computers, while the second deals with computer applications to typesetting. Fundamentals with nine examples of applications, principally newspaper.
 125. Jones, William C. 1963. Automation in Typesetting. *Graphic Arts Progress* 10: unpaginated. July-Aug. 1963. In this issue articles concerned with automation of composing are summarized. Following an introduction the topics covered are: newspapers, directories, and computer-phototypesetting. Appended are 21 references.

126. Kaiser, W. A.; Schiebeler, W. 1965. High Speed Teleprinter System. In 1965 IEEE Int. Conv. Rec. Part 1, p. 131-136. Institute of Electrical and Electronic Engineers, New York City 10017. Electronic system able to transmit, receive, and print out telegraph and data messages at a maximum speed of 225 characters per second or 1800 bands, utilizing electrolytic inking of ordinary typewriter paper. Usable on radio.
127. KALVAR: Unique System of Dry Photography. 1964. Book Production Mag. 79: 58-60. June 1964. A completely different film is developed simply by heating it—eliminating all darkrooms and chemicals. Three KALVAR products designed for printing are Converkal, Kalvalith, and Kalvaton.
128. Kraft, F. R. 1963. The Reduction in Bulk Resulting from the Typesetting of Documents in Modern Composition Systems. In: Luhn, H. P., editor, Automation and Scientific Commun. p. 275-276. (See Am. Doc. 7/64-151.) A 43-page, typewritten article occupied only 22 pages when automatically made up by a computer and produced by a Linofilm phototypesetter. . . . three pages of tables produced in like manner could fit on only one type-set page without reduction in readability. (Author)
129. Kretzmer, E. R. 1965. Facsimile Communication via the Dialed Telephone Network. In 1965 IEEE Int. Conv. Rec. Part 1, p. 138-43. Institute of Electrical and Electronic Engineers, New York City 10017. Satisfactory signal preservation requires auxiliary communication and control features, such as remote synchronization, two-way signaling, automatic answering, etc. Related to new Data-Phone.
130. Kubilius, Walter. 1964. A Basic Guide to Computers for the Printing Industry. Printing Mag./Nat'l. Lith. 88: 48-50, June 1964; Part 2, p. 40-41, July 1964. Typesetting techniques are being revolutionized through the development of new types of computers. For the Graphic Arts, their operations may be complex—but their significance for printers can be readily grasped, as this "Primer for Printers" on computers demonstrates in simple terms.
131. Kubilius, Walter. 1964. Looking Ahead in the Graphic Arts Industry. Printing Mag./Nat'l. Lith. 88: 50-53. Jan. 1964. New printing technologies destined to change the nature of the industry in the next half-century. This dramatic preview illustrates the drawing board plans of today which will be tomorrow's plant realities.
132. Kubilius, Walter. 1963. Typesetting via Computers. Printing Mag. 87: 64-65, 103. Mar. 1963. A report on what computers mean to commercial printers and how they can be used to cut production costs in copy editing and composition. . . . The electronic data processing age for printing is here—and those who fail to see it may be priced out of the market within a few years. Now is the time to prepare for it. (Author)
133. Kuney, Joseph H. 1963. Analysis of the Role of the Computer in the Reproduction and Distribution of Scientific Papers. In: Luhn, H. P., editor, Automation and Scientific Communication, Topic 2: Recording of Information. Washington, D.C. Am. Doc. Inst. p. 249-250. The American Chemical Society has begun an analysis of the role of the computer in related aspects of the reproduction, distribution, and retrieval of scientific information. Initial work will attempt to solve problems of photocomposition via computer. (Author)

134. Kuney, Joseph H. 1965. Progress in Computerized Typesetting. A paper presented before the Research and Engineering Council of the Graphic Arts Industry, Inc. Washington, D.C. Mar. 2, 1965. A statement of current activities at the American Chemical Society related not only to computerized typesetting, but also to information storage and retrieval. Many problems remain unsolved, including the obvious ones of setting tabular material, mathematics, and the handling of corrections.
135. Kuney, Joseph H.; Lazorchak, Bernard G. 1964. Proceedings of the Annual Meeting Am. Doc. Inst. 1964. Washington, D.C. Am. Doc. Inst. p. 303-305. Photocomposition of chemical structures has been achieved and the method seems suited to computer processing and is under study. The procedure is described and illustrated with samples of work. Associated research is mentioned.
136. Lang, W. Y. 1965. Advances in Printing Telegraph in 1964. In 1965 IEEE Int. Conv. Rec. Part 1, p. 292-325. Institute of Electrical and Electronic Engineers, New York City 10017. Input-output equipment here and abroad (Germany and Italy).
137. Lawson, Alexander S. 1964. Computers Could Lead to New Standards of Typesetting. *Inland Printer/Am. Lith.* 153: 70-71. June 1964. Lower cost computers which do not program word divisions may force a re-evaluation of the need for exact spacing. Legibility? Quality?
138. Lawson, Alexander S. 1963. Computers Will Be a Major Factor in Tomorrow's Typesetting. *Inland Printer/Am. Lith.* 151: 66-67. Aug. 1963. Printers may resist automation, but technological advances are definitely to be reckoned with. Composing rooms must follow the trends of the times. (Author)
139. Lawson, Alexander S. 1963. Installations Prove Advantages of the Computerized Typesetting. 1963. *Inland Printer/Am. Lith.* 151: 100-101. Sept. 1963. Three newspapers are now using computers, but their approaches differ. One of the most fascinating problems is that of hyphenation and justification. (Author)
140. Lawson, Alexander S. 1964. Modern Inventions Have Not Made Compositor a Dead Duck. *Inland Printer/Am. Lith.* 153: 78-79. Sept. 1964. The demise of the composing room craftsman is forecast every time a new machine enters the scene, but new developments have only made the compositor refine his techniques, rather than render them obsolete.
141. Lawson, Alexander S. 1964. New Phototypesetters Are Big Step Toward Automated Typesetting. *Inland Printer/Am. Lith.* 154: 58-59. Dec. 1964. Until now, none of the photo units even began to take advantage of the speed of computers. The second-generation machines are a step in this direction. (Author) Commentary on the later machines.
142. LeBrun, Thomas Q. 1963. An Electronic Retina Optical Character Reading System with Integral Logical Editing and Indexing Capabilities. In: Luhn, H. P., editor, *Automation and Scientific Commun.* p. 149-150 (See Am. Doc. 7/64-151). Recognizes five or more intermixed type fonts with numerals, upper and lower case alphabetical characters, and special symbols in each. It is possible to change the vocabulary of the system on-site. A mark-sensing capability is optional. The Reader operates at rates up to 2,400 characters per second. (Author)
143. Lithographers View Impact of New Procedures. 1964. *Printing Mag./Natl.*

- Lith. 88: 114-118 ff. Oct. 1964. Automated gains are dealt with by W. L. Hewitt, v.p. Intertype Division. 10,000 tape operated machines have been installed since WW II. In 1949 the first Fotosetter was installed at the Government Printing Office. One tape can control the output of 12 or more machines and set full-size newspaper page in five minutes.
144. Long, Henry R.; Gray, Robert. 1964. How Electronics Affects Today's Offset Lithography. *Inland Printer/Am. Lith.* 154: 60-61. Nov. 1964; Part 2. How a Photoelectric Tube Circuit Works. Dec. 1964, p. 50-51. Printers and lithographers are finding themselves confronted with increasingly technical developments. This explanation, in layman's vocabulary, will help you to understand this new field.
 145. Look Out Ahead! 1965. *British Printer* 78: 84-89. Jan. 1965. Modern technological developments have made a significant impact on traditional methods of printing. This article points to some of the directions from which further changes can be expected. When men with computers to sell see a market, they are quick in playing the right cards to capture it—and this goes for a number of other fields which now overlap printing. (Author)
 146. Love, G. N. 1964. Printing Unions Vote to Merge. *AFL-CIO News*. Jan. 18, 1964: 1. Photographers and lithographers approve merger and set date for merger convention of new Lithographers and Photoengravers International Union.
 147. Luce, D. A.; Barnett, M. P. 1963. Practical Operating Experience with a Tape Controlled Photon S-560 Unit. In *Automation and Scientific Commun.* (See *Am. Doc.* 7/64-151.) This apparatus has been in use at Cooperative Computing Laboratory, Mass. Inst. of Tech., since April 1963, to set material with typographic quality.
 148. Maynard, T. G. 1965. The Case for ECG [Electronic Character Generation]. An address before the International Conference on Computerized Typesetting. Sponsored by the Research and Engineering Council of the Graphic Arts Industry, Inc. Washington, D.C. Mar. 3, 1965. Electronic character generation is the process of decoding computer-generated data on magnetic tape and displaying the indicated characters properly placed on the face of a cathode-ray tube where the images so produced are photographed. Resultant film can be enlarged to prepare offset negatives for mass printing.
 149. MMM Plans Research Center Testing New Printing Industry Products. 1964. *Typographical J.* 145: 17. July 1964. This very short notice is included to indicate research efforts getting under way: 550,000 sq. ft. combination laboratory and pilot plant in Maplewood, Minn., a St. Paul suburb.
 150. Munson, Fred C. 1963. History of the Lithographers Union. Cambridge, Mass. The Wertheim Committee on Industrial Relations. Harvard University. 320 p. A related book to: *Labor Relations in the Lithographic Industry*, by the same author. No index. A direct and often the most evident result of new work processes is the unemployment of workers displaced by the new process. No union can ignore this peril, for job security is the heart of trade unionism. But freezing men into jobs will not necessarily provide job security; it may indeed have the opposite effect. (Author)
 151. Munson, Fred C. 1963. *Labor Relations in the Lithographic Industry*. Harvard University Press. Cambridge, Mass. 272 p. A detailed study based upon an MIT doctoral thesis. "This combination of circumstances has made

- it possible for the unions to take a less jaundiced view of technological change than other unions in the printing trades, and feather bedding is both historically and currently less common in lithography than in the other branches of printing." (Author)
152. A New England Service: Computer Composition for Sale. 1964. Printing Production 94: 36-37, 85 ff. Aug. 1964. Centrally located computer in downtown Boston soon to provide service of hyphenation and justification of perforated tapes for plants located within 40-mile radius. Keydata Corp. PDP-4 computer.
 153. New Equipment and Trends in Automated Composition. 1964. Book Production Mag. 80: 36-39. Dec. 1964. Robert E. Rossell warned: ". . . a member of ITCA cannot stay in business if he ignores the new technical advances." John F. Grove said: "50 percent of the presses currently produced by H. I. are offset models, on which photo comp. is best method." Also, "money is not made in keyboarding, but in assembly." Rossell says Mergenthaler Linotron can accept magnetic tape and create an output of 1000 6-pt. characters per second in completely made-up pages.
 154. New York Daily News Installing Two-Way Computer to Process Data for Both Commercial and Production Departments. 1964. Guild Reporter 31:3. Jan. 10, 1964. Bertram E. Powers, president of the ITU's Local 6, has said that the *Daily News* computerized typesetting system will eventually displace 130 printers. He has warned that the ITU will resist introduction of the system unless printers are guaranteed job security and a share of cost savings.
 155. New York Daily News Replaces IBM 1620 with Minneapolis Honeywell 200 Which Will Also Require Negotiations with Typo Union. 1964. Guild Reporter 31: 3. Sept. 11, 1964. The computer, the IBM 1620, installed to justify and hyphenate copy for automatic typesetting machines, has remained idle while the *News* negotiated with the New York Typographical Union on terms of operating it.
 156. Newspaper Pages in Facsimile. 1964. Print in Britain 12: 27-29. May 1964. Some facts on installations in Japan, Sweden, Germany, Russia, and United States; more specifically: *Asahi Shimbun*, *Wall Street Journal*, *Dagens Nyheter*, with illustrations of input and output equipment.
 157. Newspaper Publishers and Unions Launch Joint Study. 1965. Graphic Arts Unionist 2: 26-28. Jan. 1965. LPIU, Typographical, Stereotyper, Pressmen unions and American Newspaper Publishers Association sponsor studies of application of technological advances in production departments of daily newspapers and the effect of technology on jobs.
 158. Nugent, W. R. 1963. The Automated Editing of Text via Computer and Offline Devices. In: Luhn, H. P., editor, *Automation and Scientific Commun.* p. 210-211. (See Am. Doc. 7/64-151.) Automated aids to editing of textual matter in machinable form are described, and present on-line computer techniques are discussed. The need for small-scale, inexpensive editing devices is shown. The current development of one such device, Editor 1, is described.
 159. Nunnally, John C.; Flaughner, Ronald L. 1963. Psychological Implications of Word Usage. *Science* 140: 775-781. May 17, 1963. Word usage provides clues about individual differences in learning, perception, and personality. The purpose of this article is to describe measures of individual differences

- in the words that people use. (Authors) "As a man is, so is his talk." [Seneca, A.D. 64] This article is included because it has significance in the use of such words as: automation, seniority, strike, craftsman, labor, union, attrition, and others.
160. Ohringer, Lee. 1964. Computer Input from Printing Control Tapes. A paper presented at the 16th Annual Meeting of the Technical Association of the Graphic Arts, Pittsburgh, Pa. June 3, 1964. 13 p. Concerned with computerized indexing and searching techniques; computerized typesetting system for book production. IBM 7070, IBM 7090, IBM 1401. Computer language: PENELOPE.
 161. Pannullo, John N. 1964. New Computers Are Changing Printing Industry Production Techniques. *Inland Printer/Am. Lith.* 153: 60-61. June 1964. Research on computer applications in the printing and publishing industries.
 162. Perforated Paper Tape in Automated Printing. 1965. Washington, D.C. National Bureau of Standards Scientific Information Notes 6: 7-8. June-July 1964. Library of Congress commences four-month study under arrangement by Council on Library Resources and Inforonics, Inc.
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 165. Phototypesetter Handles Computer Composition. 1964. *Printing Prod.* 94: 61, 116-117. June 1964. Photon Zip Model 900 for high-speed setting of directories, dictionaries, text on film or paper. Machine rated at 30,000 characters per minute in 6-pt. type faces. Error-free tape produced by merging. System has internal checks.
 166. Phototypesetting System Has Built-In Computers. 1964. *Printing Prod.* 94: 46-47. May 1964. Harris-Intertype develops electronic film typesetting system, which includes some computer capabilities, for handling all classes of composition. Automatic justification of lines, exposure rate of 20 characters per second are featured. (Author) Development cost stated \$2 million. Field tested at Graphic Services, Inc., and at *South Bend Tribune*.
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- and readers. Thirteen findings are briefly commented upon, based on a paper by Jack S. Scissors, Asst. Prof., Medill School of Journalism, Northwestern Univ., Evanston, Ill.
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- understand what science is doing to change in a most radical way the traditional techniques and attitudes.
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 180. Scanners—A Review of the Current Literature. 1964. *Graphic Arts Progress* 11: 1-4. May-June 1964. One page is devoted to the development and application of photo-mechanical scanners to the Graphic Arts. Two pages are devoted to a tabulation of the characteristics of commercial scanners, both color and single color. 49 references are tabulated.
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 188. Speeds List Printing! 1965. *Graphic Arts Mo.* 37: 74, 76, 78. Feb. 1965.

- Superior Data/Graphics, Los Angeles, uses photographic data processing to produce complete page negatives for printing publications containing list material. Uses Friden Justewriter and Eastman Kodak Recordak.
189. Story of a Five-Year Strike: Cost to Company and Unions. 1965. U.S. News & World Rep. Apr. 19, 1965. p. 90, 94. In Portland, an "endless" newspaper strike has ended. The two newspapers involved took losses, but managed to operate, and to survive. Seven unions lost contracts; hundreds of workers lost jobs. Cost to unions: in the millions.
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 192. Sylvester, Kim A. 1963. The Impact of Automation in Commercial Printing. *Am. Pressman* 73: 20, 22-24. July 1963. Also in *Electro and Stereo Mag.* July 1963: 44-52. Topics treated: automatic machines for copy preparation; automation in composition; the extent of automation now. The impact of automation on the commercial printing field is already far reaching and is certain to increase. . . . This research effort promises amazing things in automation for the printer in the future. (Author)
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with more than a year's experience are unable to learn new processes after six months' training, they will be returned to their former positions without loss in pay."

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